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PUBLIC NOTICES.

PATENTS AND DESIGNS ACTS, 1907 TO 1928.

Notice is Hereby Given that the B. F. GOODRICH COMPANY, of 37, West 60th Street, City and State of New York, United States of America, SEEK LEAVE to AMEND THE SPECIFICATION of LETTERS PATENT No. 364,132, granted to them for an invention entitled "Improvements in or relating to Hose Pipes and Methods of and Apparatus for Making Same."

Particulars of the proposed amendment were set forth in No. 2263 of the Official Journal (Patents), published on June 1st, 1932.

Any person or persons may give Notice of Opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of publication of the said Journal.

W. S. JARRATT,
Comptroller-General.

8606

County Borough of Swansea.

MAIN DRAINAGE SCHEME.
CONTRACT No. 9.

		Yds.
SECTION A	(BRYNMILL TO HAFOD)	4,111
" B	(HAFOD TO MORRISTON)	4,802
" C	(MORRISTON TO CLYDACH)	3,302
		12,215

WORKS FROM BRYNMILL TO CLYDACH.
(UNEMPLOYMENT RELIEF WORKS.)

The Corporation invite TENDERS for the CONSTRUCTION of approximately 7 Miles of MAIN TRUNK SEWER (principally in Brick and Concrete), of which about 5 Miles will be in TUNNEL and 2 Miles in OPEN CUTTING; together with Storm Water Drains, Culverts, Manholes, Overflows, Chambers, Stream Diversion, and other incidental works, as briefly stated below:—

Yds.	Dia.	SECTION A, B, AND C. Description.	
		SECTION A.	
506 ..	5ft. 6in. ..	Cast Iron Pipe Sewer in trench haunched in concrete	
829 ..	5ft. 6in. ..	Brick and Concrete Sewer in trench	
184 ..	5ft. 3in. ..	Ditto.	Ditto.
1004 ..	5ft. 3in. ..	Ditto. in TUNNEL	
1168 ..	4ft. 9in. ..	Ditto.	Ditto.
98 ..	4ft. 6in. ..	Ditto.	Ditto.
323 ..	4ft. 0in. ..	Ditto.	Ditto.
4111		also	
490 ..	1ft. 0in. ..	Concrete pipe S.W.D. bedded on concrete	
480 ..	2ft. 6in. ..	Ditto, surrounded with concrete	
30 ..	2ft. 3in. ..	Ditto.	Ditto.
5111 ..	41 No. ..	Brick Manholes and Overflow Chambers, and various incidental works	
		SECTION B.	
3800 ..	3ft. 6in. ..	Brick and Concrete Sewer in TUNNEL	
1053 ..	3ft. 0in. ..	Ditto.	Ditto.
100 ..	5ft. 0in. ..	Brick and Concrete Culvert, Stream Diversion in TUNNEL	
17 ..	1ft. 9in. ..	Cast Iron Pipe Sewer in Concrete in TUNNEL	
32 ..	3ft. by 2ft. ..	Brick and Concrete Sewer in TUNNEL	
33 ..	1ft. 6in. ..	Cast Iron Pipe S.W.O. Culvert in TUNNEL	
5035 ..	44 No. ..	Brick Manholes and Overflow Chambers and various incidental works	
		SECTION C.	
1614 ..	2ft. 3in. ..	Brick and Concrete Sewer in trench	
466 ..	2ft. 3in. ..	Ditto, in TUNNEL	
273 ..	2ft. 3in. ..	Cast Iron Pipe Sewer in trench	
191 ..	2ft. 0in. ..	Brick and Concrete Sewer in trench	
628 ..	2ft. 0in. ..	Ditto, in TUNNEL	
40 ..	1ft. 3in. ..	Concrete Pipe S.W.O. Culvert in TUNNEL	
3242 ..	29 No. ..	Brick Manholes and Overflow Chambers and various incidental works	

The Contractor shall submit SEPARATE TENDERS for one or more of the SECTIONS A, B, and C, comprised in Contract No. 9.

The Corporation in their absolute discretion may accept:—

(a) One Tender comprising the three Sections A, B, and C, or, alternatively,

(b) A combination of any two Tenders of any one Contractor for any two Sections, or, alternatively,

(c) A Tender of any Contractor for any one Section.

The whole of the works are UNEMPLOYMENT RELIEF WORKS, and will be subject to certain conditions laid down by the Government Unemployment Grants Committee.

On and after the 15th June, 1932, plans may be seen and specification, form of Tender, bills of quantities, and set of selected drawings obtained at the office of the Chief Engineer, Mr. J. Richard Heath, Guildhall, Swansea, on deposit of Twenty Pounds, which will be returned on receipt of a bona fide Tender (not subsequently withdrawn), together with the specification, bills of quantities and set of drawings, all of which documents are the property of the Corporation, to whom they shall be returned on demand.

NOTE.—Only a limited number of sets of drawings are available, and Contractors should therefore make early application for same.

The documents and Tenders, which shall be enclosed in a sealed registered envelope, endorsed "SWANSEA MAIN DRAINAGE, CONTRACT No. 9," must be received by the undersigned not later than Twelve Noon on the 15th July, 1932.

The lowest or any Tender will not necessarily be accepted.

H. L. LANG-COATH,
Town Clerk.

Guildhall,
Swansea,
June, 1932. 8613

North Walsham Urban District

COUNCIL.
WATERWORKS EXTENSION.
TENDER FOR A FILTRATION PLANT.

The North Walsham Urban District Council invite TENDERS for a FILTRATION PLANT.

Form of Tender, plans, and specification may be obtained from the Engineers, Messrs. J. C. Mellins and Co., 16, St. Helen's-place, E.C. 2, upon deposit of £2 2s., which will be returned upon the receipt of a bona fide Tender and return of all documents.

Tenders are to be sent in a sealed envelope endorsed "Tender for Filtration Plant," and are to reach my office not later than Saturday, July 2nd, 1932.

The Council do not bind themselves to accept the lowest or any Tender.

H. W. T. EMPSON,
Clerk to the North Walsham Urban District Council.

North Walsham,
Norfolk. 8608

The Engineer

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North Walsham Urban District

COUNCIL.
WATERWORKS EXTENSION.
TENDER FOR A PUMPING PLANT.

The North Walsham Urban District Council invite TENDERS for a PUMPING PLANT.

Form of Tender, plans, and specification may be obtained from the Engineers, Messrs. J. C. Mellins and Co., 16, St. Helens-place, E.C. 2, upon deposit of £2 2s., which will be returned upon the receipt of a bona fide Tender and return of all documents.

Tenders are to be sent in a sealed envelope endorsed "Tender for Pumping Plant," and to reach my office not later than Saturday, July 2nd, 1932.

The Council do not bind themselves to accept the lowest or any Tender.

H. W. T. EMPSON,
Clerk to the North Walsham Urban District Council.

North Walsham,
Norfolk. 8607

North Walsham Urban District

COUNCIL.
WATERWORKS EXTENSION.
TENDER FOR BORE-HOLE.

The North Walsham Urban District Council invite TENDERS for the SINKING of a BORE-HOLE and EXTENSION of HEADINGS, &c.

Form of Tender, plans, and specification may be obtained from the Engineers, Messrs. J. C. Mellins and Co., 16, St. Helen's-place, E.C. 2, upon deposit of £2 2s., which will be returned upon the receipt of a bona fide Tender and return of all documents.

Tenders are to be sent in a sealed envelope endorsed "Tender for Bore-hole, &c.," and are to reach my office not later than Saturday, July 23rd, 1932.

The Council do not bind themselves to accept the lowest or any Tender.

H. W. T. EMPSON,
Clerk to the North Walsham Urban District Council.

North Walsham,
Norfolk. 8609

The Madras and Southern

MAHRATTA RAILWAY COMPANY, Limited, invite TENDERS for:—

(1) 81,000 BEARING PLATES.
(2) 900,000 DOG SPIKES.

Tenders are due in on Tuesday, 21st June, 1932, by 2.00 p.m. Tender forms obtainable at address below, fee ONE GUINEA each, WHICH WILL NOT BE RETURNED.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices:—
25, Buckingham Palace-road, Westminster, S.W. 1. 8619

PUBLIC NOTICES.

The Bengal and North-Western

RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of:—

400 PRS. WHEELS AND AXLES FOR WAGONS, as per specification to be seen at the Company's Offices.

Tenders, addressed to the undersigned, and envelope marked "Tender for Wheels and Axles," with name of firm tendering, to be lodged not later than Noon on the 21st day of June, 1932.

For each specification a fee of £1 will be charged, which cannot, under any circumstances, be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
W. R. IZAT,
Managing Director.

237, Gresham House,
Old Broad-street, London, E.C. 2.
7th June, 1932. 8614

River Trent Catchment Board.

TEMPORARY ENGINEERING STAFF FOR RIVER SURVEY WORK.

APPLICATIONS are INVITED for the undermentioned POSITIONS in the Engineer's Department. The appointments will be temporary, but the period of engagement will not be less than one year.

THREE SENIOR ENGINEERING ASSISTANTS.

Salaries, £300 per annum, with travelling expenses. One of the Assistants, who will be placed in charge, will receive additional remuneration of £25 per annum.

Applicants for these positions must be experienced in tidal and non-tidal river surveying and must be neat and accurate draughtsmen.

THREE JUNIOR ENGINEERING ASSISTANTS.

Salaries, £150 per annum, with travelling expenses.

Applicants for these positions must have completed their articles with a qualified civil engineer, be capable draughtsmen, and have had experience of surveying and levelling.

Applications, stating age, qualifications and experience, whether married or single, endorsed "Senior Engineering Assistant" or "Junior Engineering Assistant," as the case may be, and accompanied by copies of not more than three recent testimonials, must be forwarded to me on or before Monday, the 20th June, 1932.

JOHN HIRST, Solicitor,
Clerk of the Board.
Vernon House, Friar-lane, Nottingham. 8622

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THE PROPRIETOR of BRITISH PATENT No. 251,962, dated May 6, 1925, relating to "Improvements in Heating Apparatus," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—Enquiries to B. SINGER, Steger Building, Chicago, Illinois. 8579 H

THE PROPRIETOR of BRITISH PATENT No. 235,413, dated July 28, 1924, pertaining to "Improvements relating to Walking Beams for Use in Connection with Wells," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—Enquiries to B. SINGER, Steger Building, Chicago, Illinois. 8580 H

THE PROPRIETOR of BRITISH PATENT No. 189,827, dated July 6th, 1921, relating to "Rotary Drills for Boring Wells and the Like," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—Enquiries to B. SINGER, Steger Building Chicago, Illinois. 8610 H

THE PROPRIETORS of BRITISH PATENT No. 229,561, relating to "Pressing or Punching Apparatus," are DESIROUS of ENTERING into ARRANGEMENTS with British Manufacturers with a view to the SALE or COMMERCIAL EXPLOITATION of the INVENTION protected by the said patent.
Interested parties are invited to communicate with the undersigned for further particulars.
H. N. and W. S. SKERRETT, Patent Agents, 24, Temple-row, Birmingham. 8624 H

THE PROPRIETOR of BRITISH PATENT No. 308,631, dated November 24th, 1927, relating to "Improvements in Apparatus for Discharging and Placing Concrete and the like Pneumatically," is DESIROUS of ENTERING into ARRANGEMENTS by way of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above patent and ensuring its practical working in Great Britain.—Inquiries to Mr. B. SINGER, Chrysler Building, New York City, N.Y., U.S.A. 8611 H

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A Seven-Day Journal

A Steel Makers' Amalgamation Scheme.

THE announcement is made that a fusion of interests has been arranged between Stewarts and Lloyds, Ltd., of Glasgow, and the United Steel Companies, which own the Workington Iron and Steel Company and a group of other concerns, including strip and bar mills. The firms, which represent together about thirteen millions of capital, state that the new situation brought about by the imposition of tariffs encourages and requires undertakings in the steel and complementary trades to plan for the future and to enter into arrangements having for their object the economic development of the industry and the prevention of overlapping and duplication of plant for those markets in which the productive capacity is already sufficient for the demand. They are of opinion that such development of the steel industry is in the national interest, and believe that the expression of an intention by two or more undertakings to co-operate in a general policy will be helpful in advancing this object. They have therefore agreed, first, to co-operate in the policy of extensions in steel production and avoidance of uneconomic duplication of plant; secondly, to co-operate in sales policy; thirdly, to co-operate in research, technical development, and production methods.

Gas for Road Vehicles.

AT the annual meeting of the Institution of Gas Engineers, which opened last Tuesday, June 7th, in London, reference was made by Dr. C. M. Walter, engineer in charge of the Industrial Research Laboratories of the Birmingham Gas Department, to the possibility of driving road vehicles by the use of gas. He described experiments that had been made and stated that the difficulty in the past had been that of storage owing to the weight of the containers. Progress in metallurgy had helped to overcome that difficulty by developing high tensile steels, from which bottles capable of storing gas at a pressure of 3000 lb. per square inch with a high factor of safety could be made. Experiments in Paris proved beyond doubt that under certain conditions town's gas could be utilised for the running of certain types of heavy motor vehicle with definite advantage as compared with petrol. A series of tests was carried out by the Gas Committee of the Birmingham Corporation leading to the conclusions that the thermal efficiency of high-speed internal combustion engines, when supercharged, was greater when using town's gas than when using petrol; that the performance of the engine was much improved by saturating the gas with benzine or benzole; that with gas at a reasonable price there was a considerable saving in the cost of fuel as compared with petrol; and that, from the results so far obtained, it appeared that gas at 6d. a therm corresponded with petrol at 9¼d. a gallon.

Manchester Electricity.

THE total sales of electricity by the Manchester electricity undertaking for the year ended March 31st last, amounted to 398·6 million kilowatt-hours, an increase of 20·9 millions, being 5·5 per cent., as compared with the previous year. This is the highest figure on record, and considering the industrial depression must be regarded as very satisfactory. The number of consumers increased during the year by 8598, which is much the highest figure ever recorded, and brings the total connected to 76,375. The total revenue from sales of electricity showed a net increase of £67,224, being 3·8 per cent. In spite of a further serious decline of 7·7 million kWh in engineering works consumption, supplies for industrial power as a whole showed a particularly encouraging increase for the year of 2·4 million kWh. The principal increases in sectional sales were as follow:—Commercial, institutional, and domestic, 7·0 million kWh; industrial textile, 4·5; industrial chemical and rubber, 1·1; industrial miscellaneous, 4·5; bulk, 12·1 million kWh. A slight increase was shown in street lighting and a further decrease of 1·75 million in street traction. The addition to the number of cookers in use was 2019, making the total connected 10,779. The quantity of electricity absorbed in the mains and distributing stations as a whole was 67·86 million kWh, being 13·59 per cent. of the total kilowatt-hours generated. The average weight of fuel consumed per kilowatt-hour of electricity sold was 1·92 lb., compared with 1·91 lb. in the preceding year.

Efficiency of British Shipping.

IN the annual report of the Chamber of Shipping of the United Kingdom it is stated that the relative efficiency of British shipping has been well maintained. Nearly 50 per cent. of British tonnage is under ten years of age, so that out of 22,000,000 tons of world shipping of over 1000 tons and under ten years old, more than 40 per cent. is owned by Great Britain. Less than 17 per cent. of British tonnage is more than twenty years old. Competition has compelled ever-increasing efficiency in design and speed and size and equipment of vessels. Great Britain possesses the finest and most economical merchant fleet in the world. That British ships are not paying their way at the moment is caused partly by a reduction in world trade and partly by the surplus of world tonnage. Shipping in other countries, however, especially that of those which have over-built and those which remain on the gold standard, is suffering even more acutely. This fact is well illustrated by the figures of laid-up tonnage. During 1931 gross tonnage laid up in United Kingdom ports was on the average 3¼ million tons, as compared with 1¼ million tons in 1930. At the moment it is just over 3 million tons. The estimated total tonnage laid up in the world is, however, 12 million gross tons, or 17 per cent. of the whole, including over a quarter of the deadweight tanker tonnage of the world. Had trade increased normally, the report states, the total amount of tonnage would not be more than necessary to carry it. World trade, however, has lagged behind. The League of Nations calculated that, notwithstanding an increase of 10 per cent. in population, the volume of world trade was only 20 per cent. higher in 1928 than in 1914, and it has fallen off so much that it is doubtful whether to-day it exceeds the pre-war figure.

British Railways.

FIGURES which show the difficult financial position of the four British railway groups were laid before the Railway Rates Tribunal by Mr. Bruce Thomas, K.C., on Tuesday last. The net revenue of the railways, from all sources, fell from £45 million in 1929 to £37¾ million in 1930, and to £33¼ million in 1931. Since the "standard" revenue is about £50 million a year, including allowances, it will be seen that the railways were short by £5 million in '29, by over £12 million in '30, and by nearly £17 million last year. This very serious fall is mainly accounted for by the diminution of traffic. Goods, exclusive of live stock, dropped in tonnage from nearly 400 million in '29 to 328¼ million last year, whilst passengers, season ticket holders excluded, numbered only 795 million in 1931 compared with 870 million in '29. The gross receipts for the three years '29, '30 '31 were £177 million, £167 million and £153¼ million, and for the first twenty-one weeks of this year they were £5 million less than for the same period last year. Giving evidence, Sir Ralph Wedgwood said that there was a very marked diminution of imports and that he could recall no case in which the tariff had led to local increase in production. He saw no signs of an early improvement, and he feared that a wholesale reduction of the ordinary passenger fare from three halfpence to a penny a mile would involve the railways in a heavy loss; he did not think that a reduction of goods rates would help them as long as an industrial depression of a general nature persisted.

Birthday Honours.

IN the list of Birthday Honours conferred by the King, the following names are to be found:—Sir Frederick William Lewis, Chairman of the Development (Public Utility) Advisory Committee, chairman of Furness, Withy and Co., Ltd., is created Baron for public services. Knighthoods are conferred upon Robert Henry Davis, governing director of Siebe, Gorman and Co., Ltd., for the invention of the Davis submersible escape apparatus and of a submersible decompression chamber for use in deep sea diving; William Francis Fladgate, M.V.O., chairman of the London Power Company, Ltd., and of the Charing Cross Electricity Supply Company, Ltd.; William John Firth, deputy chairman of Richard Thomas and Co., Ltd.; John Davenport Siddeley, C.B.E., F.R.Ae.S., chairman and managing director of Armstrong Siddeley Motors, Ltd., for public services in connection with mechanical developments in the Defence Forces; Raymond Unwin, F.R.I.B.A., President of the Royal Institute of British Architects, Chief Adviser to the Greater London Regional Town Planning Committee; and Arthur Henry Preece, M. Inst. C.E., M. Inst. E.E., of the firm of Preece, Cardew and Rider, consulting engineers to the Crown Agents for the Colonies. In the Indian service Joseph Benjamin George Smith, C.I.E., Chief Engineer and Secretary to the Government of the Punjab in the Public Works Department, Irrigation Branch, and Arnold Albert Musto, C.I.E., M. Inst. C.E., Superintending Engineer, Lloyd Barrage Circle, Sukkur, are also made Knights. Engineer Rear-Admiral Harold Arthur Brown and Mr. Roger Gaskell Hetherington, O.B.E., Chief Engineering Inspector, Ministry of Health, each become C.B. in the Military and Civil Divisions respectively.

Steel and Protection.

IN a leading article to-day we comment on the appointment of a National Steel Committee by the Import Duties Advisory Committee. The duties of the Committee will be to effect such a reorganisation of the iron and steel industry as will satisfy the main Committee. If it fails to do so the main Committee may withdraw the 22½ emergency tariff by which the industry is now protected. The Chairman of the National Committee is Mr. Charles Mitchell, chairman of Dorman, Long and Co., and the other members are Messrs. E. J. George (Consett), A. N. McQuistan (Cargo Fleet), John Craig (Colvilles), Walter Gray (Steel Company of Scotland), Andrew Gray (Lanarkshire Steel), Sir John Beale (Guest, Keen), W. J. Firth (Thomas and Co.), Frank Rees (S. Wales Siemens), Captain R. S. Hilton (United Steel), F. Clements (Park Gate), H. A. Davies (Patent Shaft and Axletree), J. E. James (Lancashire Steel), H. Summers (John Summers), A. C. MacDiarmid (Stewarts and Lloyds), E. J. Fox (Stanton), G. H. Johnson (Kettering Iron), D. N. Turner (Staveley), W. R. Lysaght (Lysaght), Major A. Hibbert (Millom and Askham), J. Davison (Barrow Hematite), and A. J. Grant (Thomas Firth). In all cases the members are chairmen or managing directors of the firms named. The Secretary of the Committee is Sir William Larke, director of the National Federation of Iron and Steel Manufacturers, and M. S. Birkett, secretary of that Federation, is Assistant Secretary. The first meeting of the Committee was held on Tuesday last.

International Trade.

THE abnormal unemployment in the ranks of foremen and others holding leading positions in the engineering, shipbuilding, and allied industries of the country, owing to the world-wide economic and industrial blizzard, was referred to by Mr. George B. Richardson, chairman of the Foremen's Mutual Benefit Society, at the thirty-third annual meeting of the Society held in Llandudno last week. Dealing with the grave problem of unemployment amongst foremen, he stated that while this reached an unprecedentedly high level last year, there was unfortunately no sign of immediate improvement, and consequently the position continued to give great anxiety. The causes of the distressed state of so many trades and the resultant volume of unemployment were most complex. He hoped, however, that before long the clouds of adversity would be dissipated. It was unlikely, however, that advance would be made until a moral transformation of the peoples of the world took place. They must be taught the interdependence of each other; that the impoverishment or ruin of a neighbour inevitably reacted on themselves; that gold was of use only to rectify trade balances, and must not be hoarded and rendered inert; that customs tariffs must be moderate; and that international arrangements must be made by which nations with surplus populations might be given a suitable outlet for the excess. All this could be done only gradually, but if Ministers of State throughout the world courageously told the unvarnished truth to their people, there would be a revived spirit of confidence and goodwill which would undoubtedly help to dispel international suspicion and jealousy and render the task easier.

L.M.S. Railway's "Efficiency Census."

THE L.M.S. Railway reports that a recent one-day census of all general merchandise traffic handled by the company shows that in the case of over 100,000 consignments conveyed by goods train, 92 per cent. were actually in the possession of the consignees on the second day after being handed to the L.M.S. In the case of consignments passing to the larger towns, no less than 89·5 per cent. were in the hands of the consignees on the day after despatch. Having regard to the fact that the L.M.S. is dealing by goods train with consignments totalling over 100,000,000 per annum, the average weight of which is no greater than 4 cwt. to 5 cwt., and that the ramifications of the system extend from Wick and Thurso in the north to London in the South and Bristol and Bournemouth in the west, the results of this "one-day census" are claimed to show a remarkable degree of freight service efficiency.

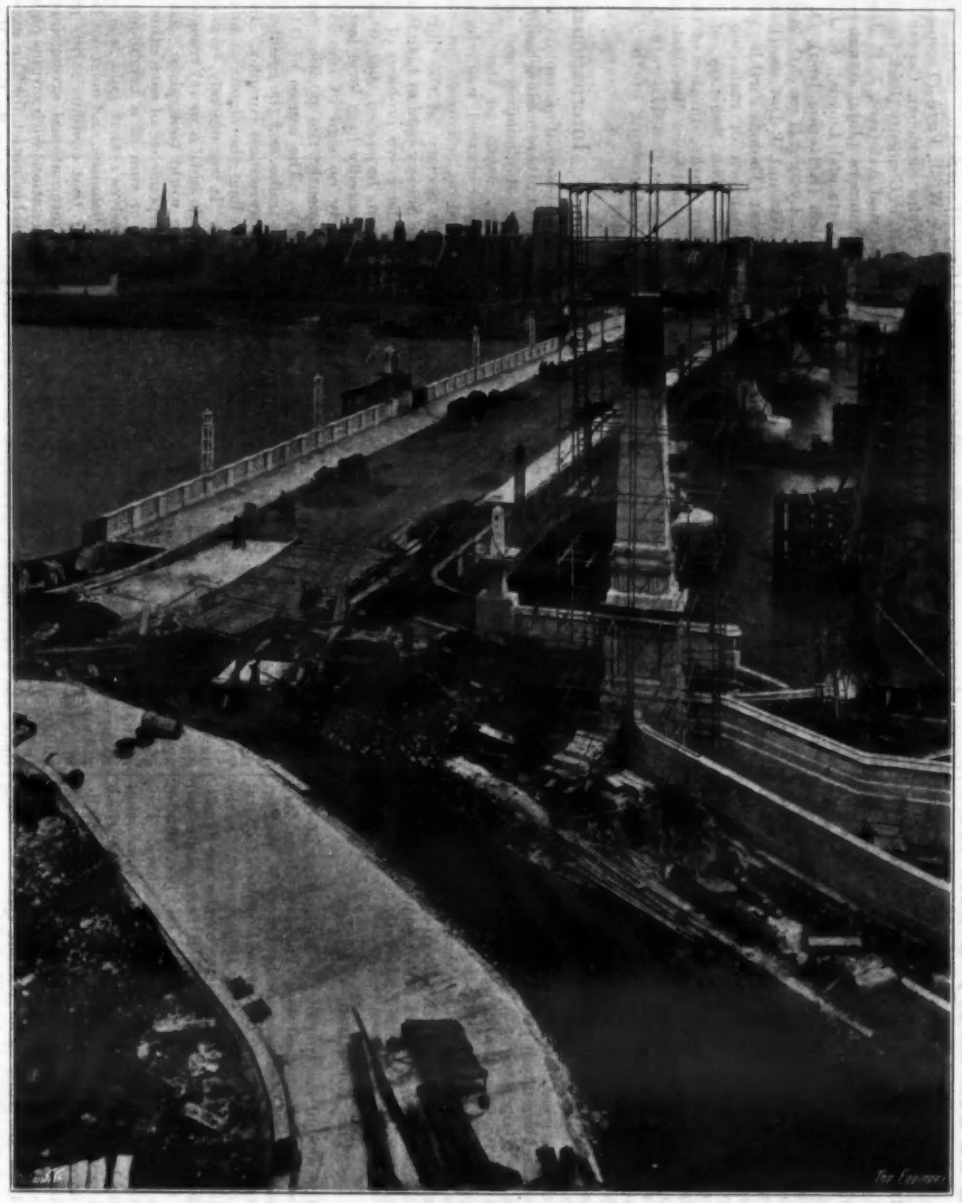
Our Overseas Trade.

AMONG the large number of messages from prominent people which the Advertising Association has received with reference to its forthcoming eighth Annual Convention, which opens at Liverpool to-morrow, one from Sir Rennell Rodd contains an interesting suggestion. "Long residence in other countries has convinced me," he states, "that though there has been some improvement recently, we have lagged behind in presenting British products and services in an attractive form to foreign countries, which are expected to study catalogues and circulars issued for Great Britain instead of receiving them in a form which they can at once understand. Especially I think we miss opportunities by not sending the best equipped agents to represent us abroad. I have long had in mind the advantage of instituting a bureau where a British house should be able at any time to find a man of education with a thorough knowledge of languages and sufficient training, ready to start like a King's Messenger at any moment for any country. The firm would be saved the cost of maintaining permanent travellers of their own, who could not, except at very high cost, be of the right calibre. These would be most carefully chosen, as personality is all-important in dealing with certain countries. Commissions on the work obtained would be apportioned between the agent and the institute. Men of the type required can readily be found to-day. Nor should a very large capital be required to start such an organisation."

ERECTION OF THE NEW LAMBETH BRIDGE

SIR GEORGE HUMPHREYS, M. INST. C.E., ENGINEER; DORMAN LONG AND CO., LTD., MIDDLESBROUGH, CONTRACTORS

(*For description see opposite page.*)



The New Lambeth Bridge.

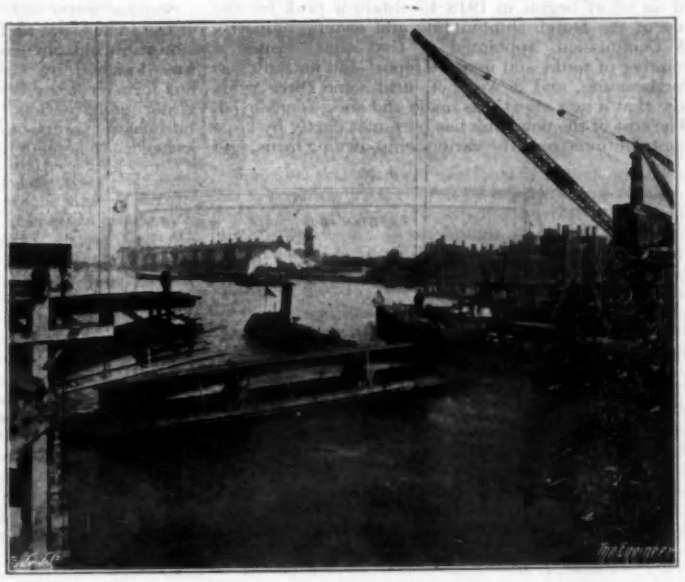
As a contribution towards the improvement of London's cross-river traffic facilities, the London County Council in 1928 decided to demolish the old wire-rope suspension bridge at Lambeth, built in 1862–3, to the design of Mr. P. W. Barlow, and to replace it by a new bridge adapted to suit modern conditions. Lambeth Bridge spans the Thames about half a mile above Westminster Bridge, and is conveniently situated to serve the needs of the new office and other development schemes now being carried out in the Millbank area.

OLD BRIDGE AND TEMPORARY FOOTBRIDGE

The old suspension bridge had three suspension spans, each measuring 280ft. from centre to centre of the piers. The new bridge, designed by Sir George Humphreys while still Chief Engineer to the London County Council and constructed and erected by Dorman, Long and Co., Ltd., Middlesbrough, has a total length of 776ft., and consists of five spans. The centre span measures 165ft., the two intermediate spans 149ft., and the two shore spans 125ft. The total width of the deck is 60ft. and consists of a 36ft. roadway and two 12ft. pathways. About 4000 tons of steel are embodied in the structure, all of which material was made and fabricated at Messrs. Dorman, Long's Middlesbrough Works. The contract for the erection of a temporary footbridge, the demolition of the old suspension bridge, the construction of the new bridge, and the removal of the temporary bridge was let in February, 1929, the price being £555,000. The contract included the reconstruction of 1700ft. of roadway at the Westminster end of the bridge, for at that end the roadway of the new bridge is 7ft. higher than it was on the old suspension bridge. The architectural features of the piers and abutments, including the obelisks flanking the entrances to the bridge, were designed by Sir Reginald Blomfield, in conjunction with Mr. G. T. Forrest, the County Council's Chief Architect.

The old suspension bridge had become so weakened that when work on its demolition was begun in June, 1929, great care had to be taken to avoid its total collapse. A view of the old bridge and the temporary footbridge is reproduced herewith. To begin with, the towers carrying the suspension ropes were reinforced by bolting stiffening angles down their corners and carrying these angles down on to the cylinders supporting the towers. By this means the towers, composed of angle iron and thin iron plating, were rendered strong enough to withstand the extra stresses thrown upon them by the demolition process. Dismantling was begun simultaneously at the mid points of the three spans, the object being to avoid subjecting the towers to bending stresses as a result of the cables of adjoining spans becoming unequally loaded. The material removed was lowered into barges until a stage was reached at which the towers were carrying nothing but the weight of the cables. By the aid of a cat-head erected over each tower the cables were then lifted one by one and lowered across three barges anchored beneath them. Thereafter each cable was cut at its mid point by oxy-acetylene and the two portions were drawn in to the respective shores of the river. After being in service for about sixty-seven years, the cables on being tested were found to possess a breaking strength of 27 tons per square inch.

CAISSON READY FOR LOWERING



LIFTING CENTRAL PORTION OF RIB

Stagings were next erected on piles round each pier for the support of 3-ton hand cranes by means of which the towers were dismantled. Thereafter the demolition of the four mid-river cylindrical piers was begun. These piers consisted of cast iron segments, 12ft. in diameter, lined internally with brickwork 3ft. thick. They were dismantled down to just above high-water level, and then were removed bodily by means of two 200-ton jacks. One of these jacks operated from the staging. The other, employed only to apply a starting force, worked from the original concrete foundation of the pier, and was lashed to the segments of the pier in order that it might be recovered. By November, 1929, the demolition of the old bridge and its piers was completed, and work was begun on the erection of the new bridge.

The new abutment at the Westminster end of the bridge has a length of 90ft. in the direction parallel with the river, and a width of 70ft. at right angles to the river. In depth it measures 46ft. along its front edge, and 14ft. along the rear edge. It is constructed of mass concrete reinforced verticaly in the higher portion, and is faced with Cornish granite. Sheet piling was driven round all four sides of the site for the abutment. The concrete was placed in four sections, the first consisting of a slab 90ft. long forming the river face of the abutment. Behind this slab the ground was excavated to permit the remainder of the abutment to be placed in three successive portions, each about 30ft. thick. The two outer of these portions were placed first. The middle section contained the foundations of the old pier and was placed last. On the Lambeth side the new abutment is about 80ft. upstream from the old one. It is of the same form and dimensions as the Westminster abutment, and was constructed in a similar manner.

The four piers for the new bridge are founded on steel caissons sunk under compressed air. As illustrated in one of the accompanying engravings, the caissons were erected and riveted up inside timber staging. When each structure was completed, it was lowered to the river bottom by means of four 200-ton hydraulic jacks. Each of these jacks operated in conjunction with a crosshead extending between a pair of link plates, which were pierced with pinholes at 12in. centres. After the caissons had reached the river bottom they were sunk into it by excavation from within. With twenty-four sinkers at work simultaneously inside the compressed air chamber, the rate of sinking averaged nearly 18in. per working day. About 4000 cubic yards of material were excavated per caisson. Above the working chambers the caissons are braced by plated cross and longitudinal girders, the webs of which are pierced with 2ft. holes to give continuity to the concrete filling.

The piers were erected on the caissons inside temporary cofferdams, composed of steel troughing and made water-tight by rubber jointings. The troughing was bolted to the top of the caisson in a manner which permitted it to be easily dismantled after the work was completed. The compressed air chambers of the caissons were filled with 4-to-1 concrete. Above, the piers were formed of 6-to-1 concrete, with a granite facing beginning about 2ft. 6in. below low-water level. At the level of the springing of the arches the piers are 99ft. 6in. long by 15ft. 8in. wide. These dimensions are maintained down to a height of 10ft. 6in. above low-water level, beyond which the piers curve gradually outwards to the full dimensions of the caissons. Above the level of springing the piers are hollow concrete structures, and are faced and buttressed with granite. The arch skewbacks rest against granite bedstones, each of which is anchored to the pier by means of four 2in. bolts, 12ft. long.

Work on the erection of the steel superstructure

of the bridge was begun in October, 1930. The central span measures 165ft. and is flanked on each side by a span of 149ft., and a span of 125ft. 4in. Each span is composed of nine steel arched ribs, of which the inner seven, all of identical design, are spaced at 6ft. 10in. apart, centre to centre, while the two outer ribs are spaced 10ft. 3in. from the nearest inner ribs. Each of the ribs is composed of three sections, namely, two end portions and a central arched portion. The two outer ribs are plated throughout, but, in the case of the inner ribs, only the central portions are plated, the end portions being provided with lattice bracing. At the panel joints the ribs are connected to each other by cross girders. These cross girders extend between the end portions and the central portions of adjacent ribs. In addition, the ribs are connected by transverse diagonal bracing, but this bracing is confined to the end portions. The roadway is supported on pressed steel troughing laid on the cross girders and ribs. Expansion joints are formed in the roadway over each pier. The outer ribs support a cast iron parapet. Gas, water, and electric mains are accommodated beneath the footways.

The method employed for the erection of the bridge was governed by the fact that whereas the span adjacent to the shore at each end is not navigable, the two intermediate spans and the central span are used by vessels and barges passing up and down the river. The work of erection was carried out by means of 20-ton cranes set up on the piers and abutments. In each case the end portions of the ribs were placed in position on their pins and were supported on timber baulks on the staging surrounding the piers or abutments. The central portions were then lifted off barges and swung into position between the end portions. In the shore spans the central portions were allowed to rest on staging erected at the middle of the span, but in the navigable spans such staging could not be employed and the central portions had to be lifted directly into position. The three portions of each rib before they were connected up were brought into correct alignment by means of hydraulic jacks, acting, in the case of the two shore spans, from the central staging and, in the case of the other spans, from the bearings on the piers. The erection programme was carried out in such a way that none of the piers at any time was called upon to take the unbalanced thrust from more than three of the ribs, the safe limit for which they had been designed.

The bridge is now almost completed. The footways are already open to pedestrians and the temporary bridge is being demolished. The formal opening of the bridge as a whole will take place in July. A number of photographs are reproduced herewith, two views of the bridge in course of construction being given on page 630.

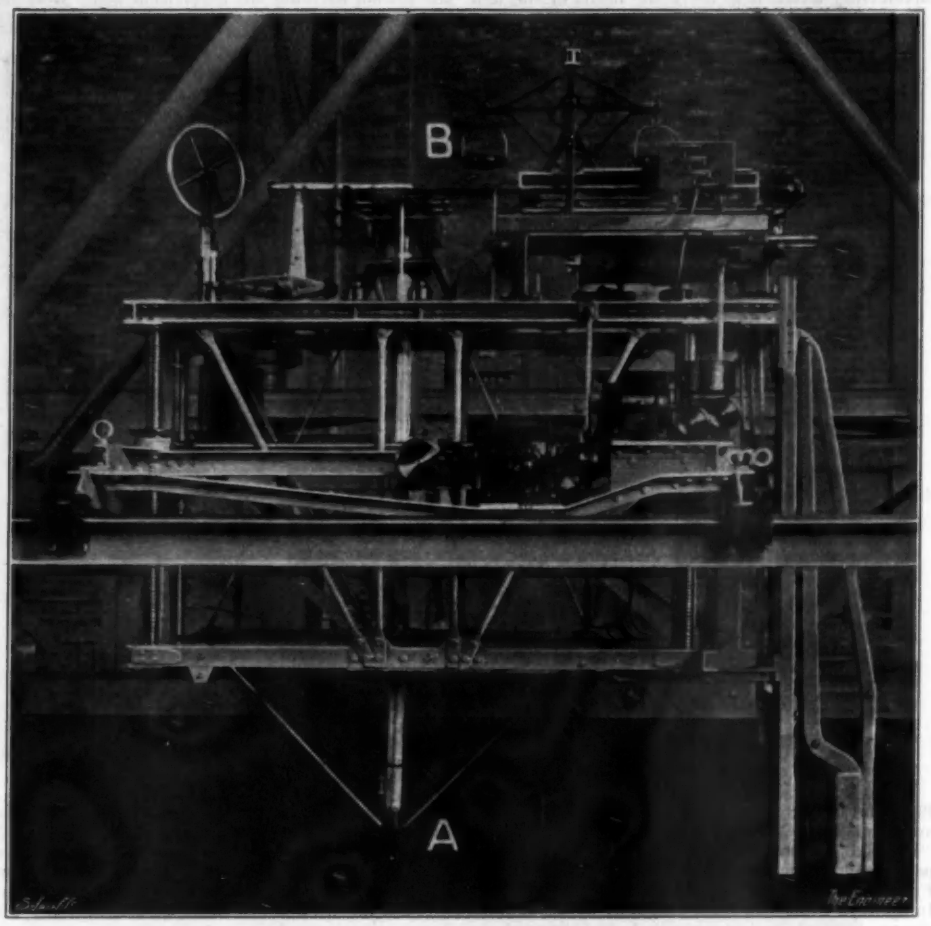


FIG. 2—RESISTANCE DYNAMOMETER OF TOWING CARRIAGE

The Netherland Ship Testing Tank.

THE official opening of the Netherland ship model testing tank on May 9th marks the completion of an effort begun in 1918 to obtain a tank for the use of the Dutch shipbuilding and owning industry. A Commission, appointed at that time, visited a number of tanks and issued a report, but nothing was forthcoming, and it was not until some three years ago that a new effort was made and success achieved. The cost of the new tank has been met partly by large contributions from the various ship-owning firms, and partly by the State. The total cost, including ground and all necessary appliances, and experimental apparatus ready for work, was some £56,000 at the normal rate of exchange.

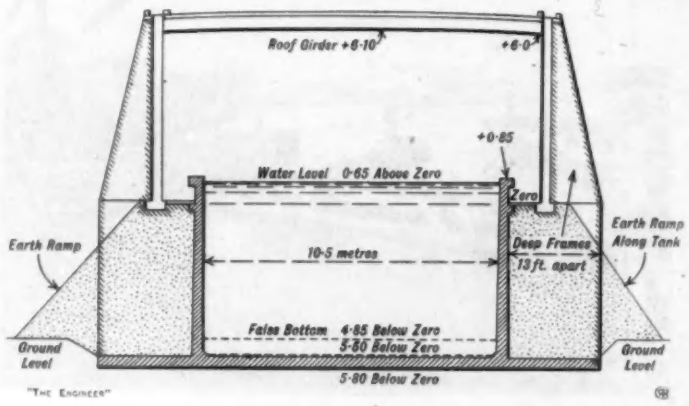


FIG. 1—CROSS-SECTION OF TANK

The tank was designed by the Superintendent, Dr. L. Troost, and has been built at Wageningen, which is about midway between Rotterdam and Amsterdam, and quite close to the Dutch botanical and chemical research establishments. The dimensions of the water basin are: Length, 530ft.; breadth, 34·2ft.; depth, 18ft. This latter measurement is taken above the "false" bottom, which itself occupies some 2·0ft. additional depth. The cross section of the water space is a rectangle, as shown in Fig. 1. Excluding the dock and sloping end of the tank, there is a clear length of about 410ft. of the full depth. To take full advantage of the available length, the trimming dock at the starting end has been placed on the centre line of the tank, so that the test run can start from this position. In addition, there have been built at the "stopping" end two large oil buffers. These will stop the carriage on impact at a speed of 10·0ft. per second, without any ill effects. Ground has been purchased at this end of the tank, and will allow of an extension of the length of the tank to roughly 900ft. at any time in the future.

Shallow water tests will form an important section of the tank work, and for this the tank is fitted with a movable bottom over the centre 310ft. This bottom was designed by Gebers, and instead of being of box form as at the Rome and Vienna tanks, is of solid girder construction, heavily covered with Dove's bitumastic composition, with a thick wood upper surface. It is made in sections, each 8 m. in length, stored at the bottom of the tank, and the whole can be raised to any level during one afternoon. One cross girder of the tank carriage is fitted with special lifting winches for this work.

The tank is made in ferro-concrete, and is built on the top of the ground, *i.e.*, there has been little excavation for it. To obtain the necessary stiffness without excessive cost, it has been constructed in comparatively thin material with deep web frames. These frames extend above the level of the top of the tank, so as to carry the roof, and with the roof girders form a complete hoop every 4 m. along the tank. The construction is similar to that of a ship, but with the deep frames outside instead of inside, and the likeness is increased by giving the roof girders a "round of beam." An earth ramp has been built against the exterior of the tank walls, up to approximately the water surface level, to protect it from atmospheric changes. This construction is illustrated in Fig. 5. The water level—see Fig. 1—is approximately 2·0ft. above the level of the path along the tank. To carry the iron sleepers for the rails the walls have a bulbed top, but generally they are 8·0in. wide at the top, varying to 11·5in. at the bottom. In order that extension of length may be made at any future time without great delay, the walls and bottom of the tank have been built some 22·0ft. beyond the end wall. This space is now used to house the intake switchboard and electric plant for driving the towing carriage.

The carriage rails are carried on short iron sleepers fixed to the top of the tank wall. The treads of these rails are scarfed into each other, and each joint is held by a double butt strap, so as to avoid any jar as the carriage wheels pass over them. Measurements of the gauge of these rails, taken before and after filling the tank with water, showed that the walls had not moved even a fraction of a millimetre.

The tank carriage and apparatus were designed by Gebers. The total weight without passengers is 15 tons. The carriage consists of two longitudinal and two cross box girders, in sectional steel, with deep central fore and aft girders of tubular construction, carrying the test apparatus. The general scheme can be gathered from Fig. 3. These central girders at their highest point are nearly 20ft. above water, this height being required for a lift wire to take part of the weight of the model when fitted with Geber's propeller gear. Each wheel of the carriage is separately driven by a 20 B.H.P. motor through single reduction gear wheels, and with this power a steady maximum speed of 28·0ft. per second can be obtained over a length of 200ft. The motors receive their supply from conductors suspended from the roof, through two sets of collectors which can be seen high on the left in Fig. 3. The carriage is fitted with special warning lights which change colour when the wheels are within certain small distances from the rail end. The steadiness of the carriage speed depends upon that of the voltage supplied to the motors. This is achieved automatically. The driver has merely to set his instruments at the voltage corresponding to the desired speed, and to accelerate to this voltage, which is maintained by valve control within one in 2000 of the set voltage. The driver is at the "stopping" end of the tank, his cabin being seen in the distance at the left in Fig. 3. The braking is partly electrical, but prony friction brakes are fitted on all the wheels, and can be put into action by the operator on the carriage at any point down the tank.

The models are of paraffin wax of length varying between 16ft. and 18ft., but the cutting machine can take models up to 26·5ft. The general scheme of model casting, cutting, and shaping is the same as in all the English tanks, except that the lines of the model are drawn on marble slabs, and their retention for any period is almost impossible or expensive. The National Tank method of preserving such lines will probably be substituted soon for this plan. The towing of the models from the carriage is done by a Geber's dynamometer of a modified and much improved type. This is shown in Fig. 2. The model

THE NETHERLAND SHIP TESTING TANK

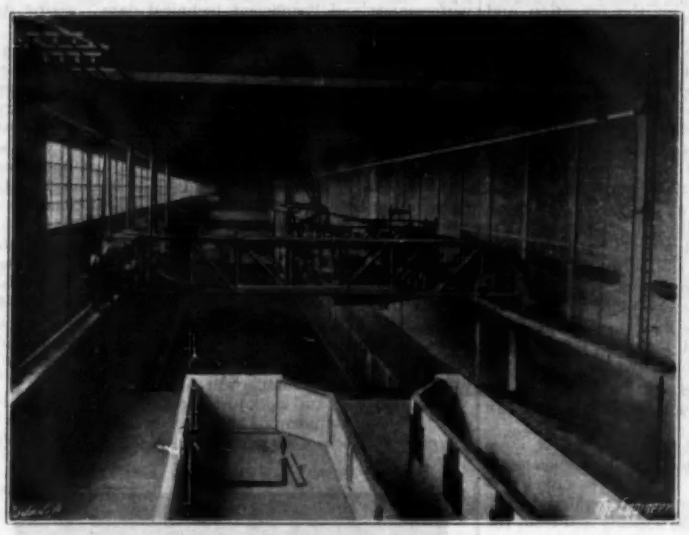


FIG. 3—GENERAL VIEW OF TOWING CARRIAGE AND TANK

FIG. 4—MODEL MAKING SHOP

is towed from the dynamometer at A, the force being balanced by weights in the pan B and by the pull of a longitudinal spring just below this pan. A small motor to the right of B automatically adjusts the tension of this spring, so that the towing dynamometer swings between two limit stops. When the steady conditions are reached, these limit stops can be widely opened, and a record of resistance is then obtained as with a "free towing Froude" dyanmometer. Quite good records are obtained in this way. Before starting each test the difference in skin friction between ship and model is worked out, and the equivalent weight is put on a towing wire at the fore end of the model. This is the normal practice of Continental tanks, but leads to some difficulty in interpreting results with screws.

The model propellers are rough cast, and cut by machinery. The cutting is done on a large machine supplied from Vienna. Lines are milled on both the pitch face and back of the blades, the section shape

FIG. 5—CONSTRUCTION OF TANK

being controlled from large-scale drawings, by means of a pantagraph copying gear. The machine is a very elaborate one, and its cost in England would be about £1250. The time taken to make a screw is about one day more than by the hand method used at the National Tank.

All testing of propellers behind models is done with internally propelled models. The torque and thrust are weighed on Geber's apparatus carried on the topsides of the model. In cargo boats this is quite satisfactory, but with fine-lined multi-screw vessels the models become unstable with this gear, and have to be supported by taking some of the weight on a vertical wire.

Equipment has also been provided for carrying out tests of flying boats and seaplane hulls and measuring their rise, trim, and resistance, but this has not yet been used. Away from the water basin there are large woodworking and machine shops on the first floor, as well as moulding and casting tanks for model making, and a very large cast iron surface table for taking off model sections. On the ground floor there are offices for draughtsmen, assistants, reception, and the superintendent, with the latest things in office equipment. In the grounds there is a large pond suitable for open-air testing, when the weather permits, which can be developed when the need arises. The superintendent, Dr. L. Troost, is an experienced naval architect, and has with him a staff of nine assistants. Promises of financial support for the first five years have been received from the State and from several firms, and one may hope that the tank will have made itself a necessity before this support ceases.

The Newcomen Society.

SUMMER MEETING.

THE venue of the Summer Meeting of the Newcomen Society for the Study of the History of Engineering and Technology this year, from June 1st to 4th, was North-East Staffordshire, a district that is far from being an industrial one, yet holds many an out-of-the-way place where manufacture is carried on.

Lichfield was selected for the headquarters, as having the right atmosphere. Members who arrived there on the evening of Wednesday were welcomed in the Guildhall by His Worship the Mayor, Alderman W. A. Wood; the Mayoress, Miss A. Wood; the Sheriff of Lichfield, and members of the Town Council. The civic regalia and the building itself were shown, and the more adventurous visitors descended to see the old condemned cells—barbarous places.

On Thursday morning, the first visit was to Cannock Chase, where, by permission of the Forestry Commissioners, who are reafforesting the Chase, and of the agents for Lord Anglesea, the Castle Ring (earthworks), sites of ancient bloomeries, bell pits and coal outcrops in Beaudesert Park, were visited. Proceeding towards Rugeley, the site of a mill pool and blast-furnace in the grounds of Fairoak House was visited by permission of the Hon. Humphry Legge. Just outside Rugeley itself, sites of an iron rolling mill and of a slitting mill were seen. The sylvan scenery, natural beauties, ruins and fine estates seen during this and the following day were a revelation to those who associate Staffordshire only with the Black Country.

At Great Haywood, the coach drew up for lunch at the Clifford Arms, and the opportunity was taken to cross over the river Trent nearby by the Essex Packhorse Bridge, *temp.* Elizabeth, one of the few such bridges remaining in this country. Continuing the journey a short stop was made at Weston to see the British Alabaster and Marble Works, occupying buildings of what was once a salt works, established in 1821. The sawing and turning of alabaster for electric light bowls and ornaments with simple but effective tools, was hurriedly glanced at. Passing through Uttoxeter—a quaint market town—and Tutbury, Fauld was reached, where the well-known alabaster quarries of Peter Ford and Sons, Ltd., were visited by permission of the managing director, Mr. Peter Ford. The material, chemically, anhydrous sulphate of lime, is quarried in this country only in one other place. At Fauld, blocks of as much as 16 tons weight have been got out. The working face is reached by an adit more than ¾ mile long, which was traversed by the party by the light of candles, for here there is no trouble with foul gases or with percolation of water. The method of under and side cutting of large blocks, holing at the back and breaking down by plug and feather—all hand work—was explained at the working face. The smaller pieces of alabaster are used in making Parian and Keene's cements by grinding in a works at a short distance away, a dusty operation which was not seen. After partaking of Mr. Ford's hospitality, a return was made to Lichfield.

The Society's dinner in the evening, graced by the presence of the Mayor, the Mayoress and other guests, passed off with great enjoyment.

On Friday an absorbingly interesting visit was paid to Tean Hall Mills, of J. and N. Philips and Co., Ltd., at Upper Tean, not far from Cheadle, where tapes, bindings, small wares, &c., are made. The coach drew up at the old half-timbered manor house, the nucleus of the establishment, now used as offices. The leaders of the party were met by Mr. W. M. Philips, who is of the sixth generation of proprietors in direct succession, in a panelled room adorned with portraits of the founders of the firm, John and Nathaniel Philips, who, as young men established themselves here in 1747 as manufacturers of "inkle," or linen tape, at first as a domestic industry. A little later, when the change-over to the factory system began to take place, they built a mill alongside the manor house. It is believed that Tean was the first place, in the case of tape, where this was done in England. Dutch workmen were brought over, especially for the bleaching and dyeing part of the process, and their influence is evidenced, for example, by the use here of the word "dutching" for tackling the loom. Tape-weaving differs principally from ordinary weaving in that the loom has twenty-four or more warps, and a corresponding number of short shuttles of special shape, actuated simultaneously by a single batten. For figured and name tapes—*e.g.*, for garments—dobbies and jacquards are naturally used, and all these kinds of weave were seen. Some of the looms bore evidence of having originally been hand looms altered to power driving when the change-over took place. Some of the machines for winding the weft on the pirns, and for warping were of early construction, but there were also modern machines, and we were particularly struck by seeing, in a separate room, modern tape-weaving machines on an entirely different principle in which the shuttle had a semi-rotary movement and the speed was eight or ten times that of the old loom. The fulling stocks and dash wheels in the finishing mill were operated by water wheels, and there was some fine old transmission gearing there. It was interesting to learn from Mr. Philips that the firm had had from the earliest days a warehouse in Manchester, whither the goods were carried on packhorses *vid* Leek and Macclesfield.

It was with difficulty that the party was got away for the next visit, which was, *vid* Cheadle, to Oakamoor, to the copper wire and tube mills of Thomas Bolton and Sons, Ltd., by permission of the managing director, Mr. W. A. Bolton. The processes of casting the ingot, rolling bars and strip, wire drawing, wire rope making, extrusion of sections, tube drawing, annealing, and pickling, were shown to the party.

To obtain tea the coach was driven to Alton Towers, a nineteenth century monstrosity of a place, built by the Earl of Shrewsbury and Talbot, as a seat, but now used as a public resort. The superb gardens, however, amply repaid the one-hour's stay there.

On Saturday morning, the ecclesiastical stone and wood carving works of Messrs. Robert Bridgeman and Son were visited by invitation of Mr. J. H. Bridgeman. Modelling and carving in alabaster, marble, and bath stone were going on. The use of the pointing machine, of which a primitive pattern is still preserved here, in carving in high relief was explained. In the wood carving and joiners' shops,

machines for fret-cutting, moulding, routing, and boring are brought into use, for roughing-out work to be subsequently finished by hand.

A visit to Dr. Johnson's birthplace, now a museum, under the enthusiastic direction of the Mayor, and a tour of the Cathedral, under the guidance of Mr. W. A. Dodd, more than filled up the morning and fittingly concluded a memorable meeting that, like nearly every other one in the past, was favoured with fine and, at times, sunny, weather.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

TRANSIENT VOLTAGE STRESSES IN POWER TRANSFORMERS.

SIR,—The series of articles under the above title by Mr. K. K. Palueff recently printed in THE ENGINEER includes a simple and clear explanation of the effects of high voltage surges on transformer windings and insulation, combined with many deductions of a controversial nature.

In the first portion of these articles the theory of oscillations and initial and final voltage distributions in a transformer winding, resulting from an incoming surge, is described. It was necessary to assume in the technical explanation that the incoming surge was of infinite length, and that, therefore, the final distribution was uniform as indicated by curve 2 of Fig. 3, page 481, April 29th. In actual practice, no surges are of infinite length, and there has been abundant evidence to show that the longest surges do not greatly exceed 60 micro-seconds. Under these practical conditions, no surge is long enough for the final distribution, as shown by curve 2, to be reached, and such oscillations as there are occur not about a line such as curve 2 but about values between curves 1 and 2. The maximum potentials due to oscillations will therefore be lower than those given by curve 8 of Fig. 3, page 481. Actual tests carried out with severe surges show that the maximum potentials to earth reached within transformer windings, whether due to oscillations or to initial or final distributions, seldom exceed the normal value due to uniform distribution. Fig. 1 herewith shows the results of some tests carried out at Hollinwood—see *Electrical Review*, January 30th, 1931. Curve A shows the maximum stresses due to oscillations. It will be seen that these stresses are nowhere worse than those corresponding to uniform distribution in the body of the winding. There is therefore profound error in regarding curve 4 of Fig. 3 or curve 8 of Fig. 13 as of practical importance, or, indeed, as indicating the most severe conditions within an ordinary transformer winding.

No experimental evidence is given of these excess stresses due to oscillations at the line end of the winding in core type transformers, but attention is concentrated on the stresses near the earthed end; in fact, Figs. 8 and 10 show clearly that for normal surges of 40 micro-seconds duration, the winding potentials do not appreciably exceed uniform values except near the earthed end of the winding. This possible increase near the earthed end also appears in Fig. 1 herewith. These excess stresses are made to appear

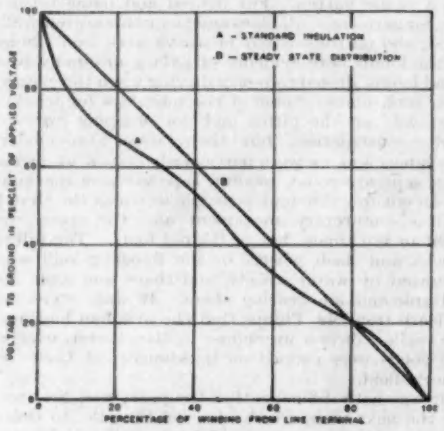


FIG. 1—SURGE VOLTAGE DISTRIBUTION IN TRANSFORMER WINDING

dangerous by assuming that the insulation of the high-tension winding is graded uniformly from the line end of the winding down to zero at the earthed end. On such a basis the stresses near the earthed end seem excessive. In actual fact, no transformer has insulation graded in such a manner. In core type transformers having concentric windings (the type most generally used), the insulation between high and low-tension windings is never, for mechanical reasons, reduced much below half the maximum value. In relation to uniform distribution therefore, the earthed end of the winding is considerably over-insulated, and the voltage stresses due to surge oscillations are even lower in relation to the insulation strength than in other portions of the winding.

All the more experienced manufacturers of transformers adopt methods of improving the surge voltage distribution by proportioning the windings dimensionally and geometrically to give a better inter-relation of capacitances between turns, coils, &c., and by fitting electro-static grading rings at the ends of the windings. Whilst these methods are not completely effective, they permit a considerable improvement in stresses with little extra cost, and no objectionable influences on the operation and performance of the transformer.

Since in practice the maximum voltages to earth (with solidly earthed neutral) obtained by oscillations from a 60 micro-second surge, differ very little from uniform distribution, it is obvious that no complicated or expensive shielding arrangement is required. It appears therefore that the non-resonating qualities of the shielded transformer described by Mr. Palueff are unnecessary. The virtue of the non-resonating transformer lies not in suppressing those oscillations, which would otherwise cause excessive potentials to earth, but in improving the initial voltage distribution, and thereby reducing the maximum stresses between turns and between coils. The shields have no effect at all on the stresses to earth at the line end of the winding. Fortunately, amplitude stresses are never serious in a well-designed transformer—see *Electrician*, May 6th, 1932, and "*E.T.Z.*," November 19th, 1931. The effect of the non-resonating winding is therefore equivalent to flattening the wave front of an incoming surge. This is the principal function of the surge absorber.

The non-resonating winding is only suitable for large and high-voltage power transformers, and is much more expensive than a surge absorber. It should be noted that all of the shields are at line potential, and require insulating, both from the remainder of the winding and from the transformer tank. The reliability of the transformer is reduced by the increase in the number of points at high potential within the winding. If, for example, the probability of the main high voltage insulation breaking down is P, the probability of failure with non-resonating shields fitted will rise to 3 P or 4 P. Mr. Palueff's division of voltage stress into three ranges is equivalent to saying that if P=zero, then 3 P and 4 P will also be zero. Whilst this is theoretically possible in the design stage, human

FIG. 2—132-kV FERRANTI TRANSFORMER ON 1000-kV SURGE TESTS

imperfections in construction and operation necessarily involve a definite risk of breakdown in practice. Large transformers cannot be made as reliable as small transformers for the same voltage conditions, unless the thicknesses of insulation are increased, so that even allowing for the larger areas involved, the probability of a transformer breaking down is no greater for the large transformer than for the small one. If this is done in the non-resonating transformer, the increase in insulation will increase the cost to a greater extent than would be expected merely from the addition of electrostatic shields.

In my view, the greater portion of Part III., page 518, May 13th, dealing with the probability of transformer failures due to surges, is of little practical value, as it is based on very long surge wave lengths, giving serious oscillations; assumes that the insulation between high and low-tension windings is graded uniformly down to zero at the earthed end of the windings; ignores entirely the effect of number of surges; and deals mainly with breakdown between high and low-tension windings due to the amplitude of the surge.

Experimental work—see *Electrical World*, December 27th, 1930, page 1187, and *Electrician*, January 30th, 1931—and practical calculations—*Electrician*, May 6th, 1932—show that in a well-designed transformer, amplitude of the surge is in itself of little danger. Fig. 2 herewith shows a 60,000-kVA, 132-kV Ferranti transformer being subjected to high-voltage surges from an artificial lightning generator at Hollinwood. After 500 severe surges, many of them over 1000 kV in amplitude, there was no external indication that the windings had been damaged by the surge. On dismantling the windings and examining them, turn by turn, numerous places of breakdown and partial breakdown were found, all of them between turns and between coils. There was no sign of failure between high-tension windings and either low-tension windings or earth.

The latter portion of Part III. deals with the surge absorber, the first criticism being that oscillograms of its performance and "sufficient technical data" giving its characteristics have not been published.

In the early stages of development of the absorber, cathode ray oscillograms were not available, but klydonographs and the results of sphere gap measurements were published some years ago—see *Electrical World*, January 26th, 1929. Operating experience, even with the earliest absorbers made, was outstandingly satisfactory. It has always been felt that data relating to actual operating experience in all parts of the world would be considerably more convincing to supply system engineers than laboratory measurements under artificially produced conditions. Laboratory measurements and experiments have, however, been carried out continuously during the last seven years to permit of detailed analysis of the operation of the absorber for design purposes, and to check mathematical calculations. The surge absorber has been, and is, so successful in operation that purely experimental and laboratory measurements to show that it ought to work are relatively unimportant.

In the experimental work just referred to, some hundreds of cathode ray oscillograms have been taken. Fig. 3 shows a typical oscillogram taken in the high-tension laboratory

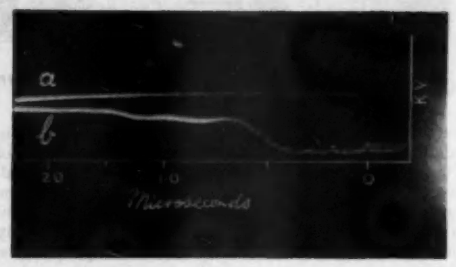


FIG. 3—OSCILLOGRAM SHOWING EFFECT OF SURGE ABSORBER

of the Technische Hochschule, Dresden, by Professor Binder. Oscillogram A shows the incoming high-voltage surge, and oscillogram B the same surge after passing through a standard 22-kV surge absorber. Similar records have been obtained on the Ferranti cathode ray oscillograph at Hollinwood. Mathematical analyses of the absorber have also been published—see *World Power*, for May, 1932, and the *Elektrotechnik und Maschinenbau* for March 20th, 1932. The oscillograms confirm in every way the results of operating experience and the original measurements with klydonographs and sphere spark gaps, and check the mathematical calculations referred to above.

Good results can be obtained with a large inductance coil, but for the reasons given by Mr. Palueff (oscillations due to its inductance and the transformer capacitance combined with the effective capacitance of the coil to earth), these results are very erratic. The percentage absorption of the absorber is consistently high for surges of all magnitudes and wave forms, whereas the percentage absorption of the choke coil varies erractically from small positive to negative values, showing that the coil may even do more harm than good, and depending upon the type and magnitude of the surge and the oscillation characteristics just described.

The surge absorber may be looked upon as including the advantages of a large inductance and capacity, with the disadvantages obviated by making the combination aperiodic through the inclusion of a large loss or resistance component. This loss component consists of the secondary winding or dissipator of the absorber, which is the seat of eddy current and resistance losses.

The experiments on a pseudo-absorber described by Mr. Palueff are of no practical importance, and Figs. 21 and 24, pages 519, 520, should not be taken as in any way representative of a standard surge absorber. Measurements, calculations, and operating experience all show that the inductance, capacitance and loss characteristics of the absorber are by no means negligible. The relative importance of these characteristics has been determined by varying the values of inductance and capacitance, and by varying the material, dimensions, and number of the energy dissipators.

Although in an ordinary transformer the most severe stresses resulting from a surge occur at the line end of the winding; in all cases severe stresses also arise in other parts of the winding, and in particular cases the reinforcement of insulation may be such that the most vulnerable parts are in the body of the winding and not at the extreme ends. Practical tests on a standard 25-kVA, 11-kV transformer—see the *Electrician*, January 30th, 1931—show that the installation of a surge absorber eliminated all breakdowns, either at the end of the winding or at any points in the interior of the winding. Without the absorber, numerous failures occurred in the middle of the winding. The results of the tests showed clearly that breakdowns may occur at any point of the winding, and that the absorber is effective in reducing stresses at these points.

Quantitative measurements of surge characteristics (and the detailed analysis of transient stresses) are difficult. The use of the cathode ray oscillograph in surge investigations is extremely complicated, and the technique for such experimental work is still in a relatively crude stage of

development. Too much reliance should not, therefore, be placed on the results of any particular form of investigation. For these reasons the performance of the surge absorber has been studied from many different aspects. The published data, for which references have been given above, show that the remarkably successful operating experience already obtained for the surge absorber in all parts of the world during the past five years, is satisfactorily confirmed by theoretical principles, experimental work, mathematical calculations, and direct measurements with the cathode ray oscillograph.

E. T. NORRIS,
Chief Designer, Ferranti, Ltd.

Hollinwood, June 1st.

RELATIVITY AND A HOLE!

SIR,—Mr. Lewis's letter in your last week's issue illustrates the necessity for precision in framing and discussing problems in relativity. I trust he will not think me captious if I point out that his two statements concerning the point of emergence of the hole are not true. It is not true that "if the drill revolves and the shaft remains stationary the result will be a hole emerging at C." Under the specified conditions no hole at all will be formed in the shaft. A relative feed movement is required. This movement may consist of a displacement of the drill or the shaft parallel with the axis of the drill, in which case the hole will emerge at C, or of a displacement of the drill, or the shaft parallel with the axis of the shaft, in which case the hole will emerge at A.

Similarly, it is not true that "if the shaft is made to revolve and the drill is stationary the hole will . . . emerge at A." It will emerge at A only if the relative feed movement is a displacement of the drill or shaft parallel with the axis of the shaft. It will emerge at C if the relative feed motion is parallel with the axis of the drill.

An observer situated at X on the shaft and having the principal axes of the drill as his sole frame of reference would be quite unable to distinguish between (*a*) the rotation of the drill while the shaft had no rotary motion, and (*b*) the rotation of the shaft while the drill had no rotary motion. In both cases he would appear to have an anti-clockwise rotation relatively to his frame of reference. But the point of emergence of the hole is *not* determined by whether the drill or the shaft is rotating, but by the direction of the relative feed motion. The observer at X would be able clearly to distinguish between relative feed motion along the line C D—one of the axes of his frame of reference—and relative feed motion along the line A B—a direction inclined to the C D axis of his frame of reference. He would at once associate the point of emergence of the hole with the direction of the relative feed motion.

I would like to suggest that as the problem is one purely of geometry and does not involve time as a factor, it has really no connection with the theory of relativity as evolved by Einstein. VIA VERITAS.

London, June 5th.

SIR,—The paradox indicated by Mr. R. Stanley Lewis can, in my mind, be explained in the following terms of the observer at X, relative to his frame of reference, the drill.

Case I.—Where the Drill "Revolves."—The observer at X perceives himself revolving round the stationary drill, which proceeds from D to emerge at C. He experiences no centrifugal force.

Case II.—Where the Shaft "Revolves."—The observer at X perceives himself revolving round the stationary drill, which proceeds from B to A. He also perceives that the drill now bends at its shank, or that the hole drilled is larger than in Case I., or a combination of these. He experiences a centrifugal force.

The true paradox appears to me to lie in the centrifugal force. FRANK RAWLINSON.

Sheffield, June 4th.

SIR,—In answer to Mr. Lewis's letter in your June 3rd issue on the above subject, besides the rotational movement a translational movement of either the shaft along its axis A B or the drill along its axis C D is required to drill the hole. The observer at X can readily determine whether the movement of the shaft relative to the drill is along the axis A B or C D. T. H. SIMPSON,

London, June 3rd. Comdr., R.N.

[Other letters on this subject have been received from correspondents in London, Delft, Crewe, Leicester, Birmingham, Ipswich and Cheadle Hulme. The three printed above may be taken as typical of them.—ED. THE E.]

ATMOSPHERIC RAILWAYS.

SIR,—The recent letters on this subject have been most interesting to all admirers of the great, old masters of our craft. The huge scale of this experiment, the short period of its trial and the many and varied misfortunes which preceded its eclipse are barely remembered in railway history. The following facts may be of interest to admirers of Brunel and his splendid failures.

Brunel constructed four railways on the atmospheric principle—one in Ireland, one in Devonshire, one in West London, and one between New Cross and Croydon. Samuda, the shipbuilder, supplied the machinery. The Croydon line was laid along the bed of the old Croydon canal. The timber ponds near New Cross Station and some pools at Forest Hill and Sydenham still remain as mementoes of the old waterway, up which traffic climbed *vid* fourteen locks. The name of the Norwood terminus, "Jolly Sailor," still graces a Norwood public-house near the junction. The railway yard near Croydon Town Hall formerly accommodated the turning loop of the atmospheric line. There is still standing, at the back of Croydon market, the ivy-covered power-house of the railway. It is now used as a waterworks pumping station.

Of the Devonshire line, two relics exist. One is the power-house chimney, near Newton Abbot. The other is a section of conduit which lay for many years in a convent garden at Paignton and is now in Kensington Museum. It is a ponderous affair, like a section of 36in. main with a longitudinal slot. The seating of the flap valve can be plainly seen.

Several proposals have been made for revival of the pneumatic system. The original plans for the South London tube provided for working the trains by air pressure. The Post Office authorities used the system for many years between City post-offices and had at one time some fine beam engines working compressors at St. Martin's le Grand.

I several times saw the top of the tube of the Pneumatic Despatch Company under Holborn during excavations. It was used as a conduit for telephone cables and was destroyed by an explosion of gas which had percolated into it. The repair of the wrecked road between Holborn Restaurant and Cambridge-circus occupied a year, but the destruction of the tube enabled the London County Council to deepen their subway and run double-deck cars between North and South London.

JOHN NEWSON, M.B.E.

Norbury, S.W. 16, June 6th.

ORDERS FOR MILLIONS GOING ABROAD.

SIR,—His Royal Highness the Prince of Wales has changed "Buy British" to "Sell British," as being more important, the point being that if all our works were more up to date and would replace their old out-of-date equipment they would be able to meet the competition and sell more British goods.

This is definitely a fact and true patriotism calls upon everyone to do their utmost to help. Let us see what we engineers can do.

Imports of electrical machinery, other prime movers, printing machines, pumps, textile machines, sewing machines, typewriters, &c., amount to about £16,000,000 a year.

Their ton value was about £164, while the British export ton value was only £100, which makes the imports 64 per cent. higher in price, and now there is the duty plus the rate of exchange.

What stops us getting these orders? It cannot be price. Does it not appear to be the efficiency of the goods?

If so, here is the solution. If we make sure that our products are at least as efficient, here are certain orders to the value of several millions, right at our door.

T. S. CATMUR, M.I. Mech. E.

Bromley, June 3rd.

Electrical Conductivity of Metals at the Lowest Temperatures.*

WITH the fairly large supplies of helium now available it is comparatively easy by the liquefaction of this gas to reach temperatures as low as 1° K. (*i.e.*, 1° C. above the absolute zero), which is the same temperature as 272° C. or 457° F. below the freezing point of water. At this low temperature a few of the metals become perfect conductors of electricity. Most of them, however, still exhibit, when so cooled, a decreasingly small, but still quite measurable, resistance to the passage of a current. In 1911 Kammerlingh Onnes at Leiden, while carrying out researches in the region of low temperatures with the aid of liquefied helium, discovered that mercury, when cooled down and solidified with liquid helium, suddenly and abruptly at about 4·2° K. became what is now designated as a superconductor of electricity. At temperatures below 4·2° K. mercury offers no measurable resistance to the passage of a current. Currents of electricity started in a ring of mercury in the superconducting state will continue apparently undiminished in intensity while the metal is in that state. The duration of these persistent induced ring currents is limited only by the length of time the cooling agent—liquid helium—will last. Other metals that exhibit this superconducting property if made sufficiently cold are lead, tin, indium, gallium, thallium, tantalum, titanum and niobium. The transition temperature for the passing of a metal from the ordinary conducting to the superconducting state is not a constant, but varies with the metal. For mercury it is 4·2° K.; for lead, 7·2° K.; tin, 3·72° K.; tantalum, 4·5° K.; thallium, 2·39° K.; indium, 3·4° K.; gallium, 1·07° K., and niobium, 8·2° K. Some alloys and chemical compounds of the metals also exhibit the superconducting phenomenon. Copper sulphate, for example, does so, though neither of the constituent elements is a superconductor. The nitrides and carbides, borides and silicides of several of the metals—such, for example, as molybdenum, tungsten, tantalum, zirconium and niobium are also superconducting at sufficiently low temperatures.

The addition of metals of the bismuth group to superconducting metals has been found, speaking generally, to raise the transition temperature of the latter. Bismuth added to lead raises the transition temperature from 7·2° K. to 8·8° K. Niobium, when chemically compounded with carbon, has a transition temperature of 10·5° K. in place of one of 8·2° K. Gold alloyed with bismuth becomes superconducting at 1·94° K., whereas neither constituent alone becomes superconducting even at the lowest temperatures obtainable. The application of mechanical stresses such as those of torsion and tension elevate the transition temperature of a superconducting metal, but the application of a magnetic field delays the appearance of superconductivity in a metal, and causes it to appear at a lower temperature than normally. If a metal with superconducting state be subjected to a gradually increasing magnetic field, a critical field strength is reached when electrical resistance reappears in the metal. The strengths of the critical fields required for different superconductors vary. An alloy of bismuth and lead, for example, at 1·2° K. requires a magnetic field of 20,000 gauss to restore the property of electrical resistance, while metallic thallium at the same temperature requires a field of only 15 gauss. Since the electrical resistance of superconducting metals is zero, no heat is produced when electrical currents are passed through them. Currents of high intensity can, therefore, be passed through superconducting wires of small diameter without melting them. Electric currents of over 1000 ampères have been so obtained in wires of small cross section. The factor that imposes a limiting value upon the current strength is the magnetic field set up in the wire by the current itself. A critical value is reached when resistance is restored to the wire by the magnetic field.

Interest in the problem of superconductivity in metals recently received a stimulus through the discovery by Professor McLennan and his collaborating associates that the transition temperatures with alternating electric fields applied are not the same for superconducting metals, as, when direct currents are passed through them. In a series of experiments with a coil of tin wire, drawn to a diameter of 0·3 mm., he has found that with direct currents the resistance of the coil began to decrease abruptly at 3·76° K. and disappeared completely at 3·70° K. Experiments with the same coil with currents of frequency $1{\cdot}1 \times 10^7$ per second gave for the corresponding temperatures 3·67° K. and 3·61° K., *i.e.*, superconductivity did not begin to appear until a temperature was reached that was below the one at which it was complete in the case of the D.C. experiments. Further experiments with higher frequencies revealed depressions of the critical transition temperature increasing in amount with the frequency. Extrapolation of the transition temperature-frequency curve, which appeared to be linear for the higher frequencies, gave 10^9 per second for the frequency corresponding to 0° K.

With tantalum wires results were obtained similar in character to those found with wires of tin and of lead. Experiments with tin wire coils showed that the observed depression of the critical temperature was not dependent upon the magnitude of the high-frequency currents in the coils and was, therefore, attributable neither to the heating of the coils above the temperature of the surrounding liquid helium, nor to the effect of the magnetic field of the currents. Experiments with wires of different sizes made with currents of the same frequency showed that the depression of the transition temperature was not a direct function of the skin effect. It would appear, then, to be a function of the frequency of the current in the metal alone. The conclusion is drawn that polarisation and orientation phenomena are involved in the production of the superconducting state in metals, and that this electrical state is somewhat analogous to the saturated magnetic state obtainable with ferro-magnetic metals. A new road of attack upon the problem of superconduction in metals seems to be opened up by the discovery of this frequency disturbance of the critical transition temperatures.

* Summary of an address delivered at the Royal Institution by J. C. M'Lennan, D.Sc., LL.D., F.R.S.

SIXTY YEARS AGO.

PROOF was scarcely wanted, so we wrote in our issue of June 14th, 1872, to convince the observant engineer that the introduction of high-pressure steam into the Navy and mercantile marine of Great Britain had completely revolutionised the construction of the marine boiler. The well-known type of flat-sided or rectangular steam generator was, when first introduced, never expected to carry more than 5 lb. pressure. As time went on and better materials and workmanship became available, the pressure was gradually raised until it became as much as 30 lb. That was about the limit for the rectangular or box boiler. At the time of writing, the most popular type of high-pressure marine boiler consisted of a circular shell about 14ft. in diameter and 10ft. or 12ft. long. Three cylindrical flues, 3ft. to 3ft. 2in. in diameter and 7ft. to 9ft. long, were fixed in the lower portion of the shell. They opened into a combustion chamber at the back, which communicated with the front of the boiler and the uptake by a number of 3in. or 4in. flue tubes. The usual safety valve load was 65 lb., and the usual hydraulic test load twice that figure. The shell plates were from ⅞in. to 1in. thick. The furnace plates were also very heavy, and the double riveted seams, with 1¼in. rivets, reminded one more of the very heaviest class of girder work than of steam boilers. The new type of boiler, we contended, was very heavy and very expensive, and, in addition, was less efficient from the point of view of the space occupied than the old rectangular form of marine boiler. A really good marine boiler for high-pressure steam was badly wanted. The cylindrical form then popular was, we maintained, nothing more than the old rectangular type strengthened and adapted to take higher pressures. No engineer would, we said, think of carrying 65 lb. in a boiler 14ft. in diameter on land. Why should it be done at sea? It was, we sought to show, fallacious to argue that the cylindrical form fitted the available space within a ship's hull. We pleaded for a recasting of ideas in the design of boilers. Our suggestion was that the single-cylinder of the modern boiler should be replaced by four small cylinders arranged in cross section at the corners of a square. The two lower cylinders were each to contain two furnaces, which were to deliver into a take-up at the back, and from that point the flue gases were to return to the front through tubes in the two upper cylinders. Such a design would, we argued, economise space and increase the grate area and heating surface that could be arranged within the boiler. A really good marine boiler, we laid it down, must be one in which the shells were so small in diameter that plates of moderate thickness might be used, or else recourse must be had to the tubulous system or to a combination of both.

Institution of Electrical Engineers.

No. II. (*conclusion*).*

SUMMER MEETING.

THE section of the party which visited Fountains Abbey on Tuesday, May 31st, took tea at Canal Gate and subsequently walked from Studley Park to Studley Roger Gate to rejoin the coaches returning to Harrogate, whilst the other section was entertained at tea at the Devonshire Arms Hotel, Bolton Bridge, by Hopkinsons, Ltd., and afterwards left for Harrogate by way of Blubberhouses Moor, passing the reservoirs of the Leeds Corporation. At 8.30 p.m. or thereabouts there was a civic reception at the Grand Hotel by his Worship the Mayor of Harrogate, Alderman Arthur Lambert Foster, J.P., and was followed by dancing until 1 a.m.

FRYSTON COLLIERY.

The first item on the programme on Wednesday, June 1st, was a visit to the Fryston Colliery of the Airedale Collieries, Ltd., where an inspection was made of the baths, lamp house, surface works, and power station. The pithead baths, which were officially opened by the Marquess of Crewe on January 16th of this year, are a great credit to the welfare

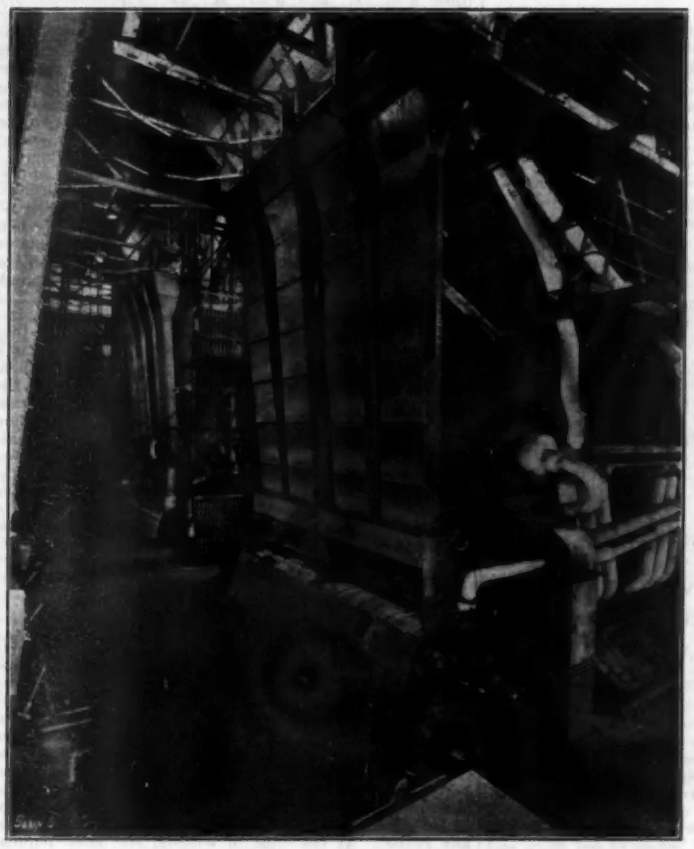


FIG. 4—PART OF NEW BOILER HOUSE

officials and architects who designed them. A gantry connects the baths and lamp cabin with the pit top, and gives protection to the men coming from the pit from exposure to chill and damp, whilst a man suffering from injury can be conveyed on a wheeled stretcher to the ambulance room and be transferred to the ambulance waiting in the adjacent garage under the best possible conditions. The two-storey building in which the baths have been installed is 160ft. long and 80ft. wide, and there are no fewer than 4080 sheet steel lockers. Each shower bath is provided with hot and cold water taps, connected to the same spray, so that the desired temperature may readily be obtained. Besides the colliery ambulance room, a first-aid room is provided on each floor for dealing with minor injuries which might otherwise be neglected. On each floor there is also a drinking fountain and a battery of taps for filling water bottles, and taps are provided in the passage leading to the lamp cabin.

The boot-cleaning equipment includes hand brushes and grease pots for men going down the pit and electrically driven revolving brush machines for men leaving it. Apart from the company's expenditure on labour and materials in connection with the lamp cabin, garages, gantries, and pit steads, estimated at £10,000, the total cost of the baths and equipment was approximately £25,000. By means of an extensive system of steel ducts, preheated and disinfected air is circulated through each locker, so that clothes contained in them are kept thoroughly dry and free from harmful germs. These pithead baths have done much to promote the comfort and health of the miners, and typify the present attitude of colliery companies with regard to their men.

AN EXHIBITION OF YORKSHIRE PRODUCTS.

On leaving the colliery, the party proceeded by motor coaches to Dewsbury, by way of Castelford, Normanton, and Wakefield, and on arriving at Dewsbury was entertained at luncheon at the Town Hall as guests of the Yorkshire Electric Power Company. On the occasion of this luncheon an exhibition was held at the Town Hall of Yorkshire industrial products, in which twenty-two firms took part. Among the engineering firms exhibiting were Jonas Woodhead and Sons, Ltd., Leeds; Kitson and Co., Ltd., Leeds; Hopkinsons, Ltd., Huddersfield; J. Blakeborough and Sons, Ltd., Brighouse; the English Electric Company, Bradford; E. Green and Sons, Ltd., Wakefield; the Yorkshire Copper Works, Ltd., Leeds; and George Bray and Co., Ltd., Leeds. The exhibition contained much of engineering and general interest, but owing to the limited amount of time available, it did not receive the attention it deserved. After luncheon and after the visitors had made a rapid tour of the exhibition, they proceeded to the Thornhill power station of the Yorkshire Electric Power Company, where tea was provided.

THORNHILL POWER STATION.

Thornhill—see Figs. 4 to 6, and 7 and 8 on page 640—was the company's original generating station, and was put into service in 1905. The available area of some 85 acres provides space for ash disposal at low cost for the next eighty years, as well as for the extension of plant. The original capacity of the plant was 4950 kW, whereas to-day it is 67,000 kW. Leaving aside the various extensions and alterations made since the station was first put into operation, the turbine house now contains two 12,500-kW, 3000 r.p.m. Parsons machines, two 6000-kW, 1500 r.p.m. B.T.H.-Curtis machines, and a 30,000-kW, 3000 r.p.m. English Electric set, referred to in our issue of May 8th, 1931. The latest extension involved the removal of the original turbines and boiler plant, and the new English Electric set shown in Fig. 8 on page 640 provides four times the original generating capacity, in the area occupied by the old sets. Owing to the favourable prices at which coal can be purchased, refinements which would be justifiable in districts where coal is more costly have not been indulged in, and the station has been designed on simple lines.

The coal is delivered in 10 and 20-ton wagons by the L.M.S. Railway, or in 70-ton barges by the Calder and Hebble Navigation, which is connected to an extensive inland waterways system covering the southern and eastern parts of the Yorkshire coalfield. At present all the coal is delivered to transfer hoppers beneath the sidings, from which it falls on two gravity bucket conveyors, which elevate it to distribution belt conveyors above the bunkers, but provision has been made for the installation of wagon tippers when it becomes necessary to deal with larger quantities of coal. The capacity of the plant is 130 tons per hour and the bunker capacity is sufficient to enable the whole of the coal handling to be done during normal working hours. As large reserves of coal are carried in stacks at the east end of the site, the company is well prepared to carry on in the event of an interruption in the supply from the pits. From the stoker grates the ashes are discharged into hoppers beneath the boilers, and are removed by electric wagons with tipping bodies, the ashes being used at present to raise the level of the adjacent land.

There are now three boiler-houses. The new boiler-house, designated No. 1 and shown in Fig. 4, replaces the original boiler-house. It contains four Stirling boilers fitted with plate type air heaters, balanced draught travelling grate stokers, and forced and induced draught fans. Each boiler evaporates 100,000 lb. of steam per hour at a pressure of 450 lb. per square inch, and at a total temperature of 750 deg. Fah. To secure ventilation and comfortable working conditions, the forced draught fans have been arranged to draw their air through the boiler-house. On account of the simplicity of its arrangement, the

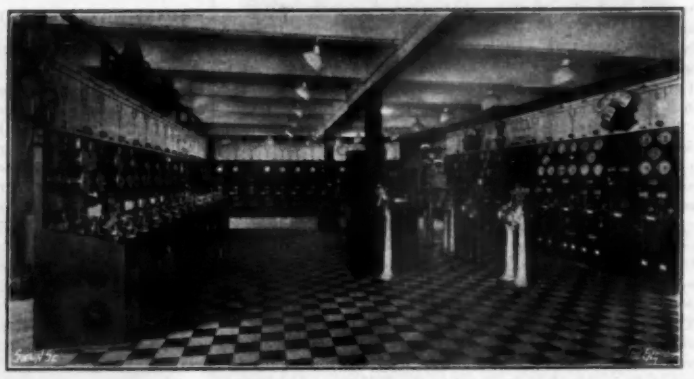


FIG. 5—CONTROL ROOM

FIG. 6—TURBINE ROOM

use of welded joints, and the liberal provision for expansion, the steam pipework is of special interest. All the main pipes are of the same diameter and the unit system has been adhered to. The feed pipework, which is designed on similar lines, provides duplicate supplies to each boiler.

Built during the war, the No. 2 boiler-house contains six boilers—three five-drum Stirling boilers, each evaporating 39,000 lb. per hour; two three-drum Stirling units, each evaporating 45,000 lb. per hour; and one Babcock-C.T.M. boiler, evaporating 50,000 lb. per hour. The working pressure of this boiler-house is 200 lb. per square inch, and the total temperature 650 deg. Fah. In the No. 3 boiler house, where steam is generated under the same conditions as those just mentioned, there are three Babcock and Wilcox C.T.M. boilers, and one Clayton and Shuttleworth double-flow boiler, each designed to evaporate 50,000 lb. per hour and fitted with chain grate stokers and induced draught fans.

Current is generated at 10,000/11,000 and at a frequency of 50 cycles per second. The two 6000 kW B.T.H. sets, which were installed during the period 1916–18, and their boilers are reserved for stand-by service. Several interesting features are embodied in the new 30,000 English Electric set, which is a two-cylinder machine designed to operate at a pressure of 415 lb. per square inch and at a temperature of 750 deg. Fah. Relays are fitted, for example, to limit the pressure to which the cylinders would be subjected in the event of the area of the steam-way

* No. I. appeared June 3rd.

through the nozzles or blading being accidentally reduced. In an endeavour to maintain the speed under these conditions the governor would increase the steam supply and portions of the cylinder would be subjected to an internal pressure which might become dangerous; but the relays avoid this occurring by reducing the steam flow to a value that can be passed without excessive pressure. To prevent continued operation on high back pressure, which might result in damage to the low-pressure cylinder or to the condenser by overheating a relay is provided to avoid the back pressure exceeding a specified value so far as it is a function of the rate of steam supply. If the pressure tends to rise above that value the steam supply is reduced, or, if necessary, shut off altogether. Hence, any accident involving an increased back pressure results in a variation in the output of the machine, but as soon as that pressure is reduced to a normal value the machine takes up its normal load. In place of the usual exhaust main a relief valve is fitted on the exhaust pipe from the high-pressure cylinder to prevent damage in the event of the relay failing to operate. The cooling air in the closed circuit is circulated by a blower which runs at half the speed of the set, viz., 1500 r.p.m.

The major part of the electrical energy generated at the Thornhill station is distributed at the generator voltage, but interconnection with the company's 33,000-volt system is provided and a separate interconnecting main between the company's three power stations is in operation at 66,000 volts. The ironclad draw-out switchgear on the 11,000-volt system has a rupturing capacity of 500,000 kVA, and that on the 33,000-volt system 800,000 kVA, and in order to reduce the short-circuit stresses on the switchgear and that on the adjacent sub-stations both the 11,000-volt and 33,000-volt bus-bars are sectionalised, and the sections are connected through current-limiting reactors. The 11,000-volt system is connected to the 33,000-volt system through duplicate banks of self-cooled transformers, each of 20,000 kVA capacity, whilst the 33,000 and 66,000-volt systems are connected through a 30,000 kVA forced cooled transformer.

Connections with the Central Electricity Board's "grid" system and connections for local supplies are made from the 33,000-volt bus-bars. In the station control room—Fig. 5—the whole output of the generators is registered, and the connections to the company's other generating stations distribution centres and the "grid" system are controlled. The amount of energy delivered to the various outgoing feeders or received from other centres is also recorded. Next to the station control room is the system control room, with a diagram of the company's high-pressure system from which the position of all switchgear in the power stations and the 730 E.H.T. sub-stations can be ascertained at any time, telephone communication being provided with the company's other power stations and all important E.H.T. sub-stations. After tea had been taken at the power-house the party left for Harrogate *vid* the outskirts of Bradford, Apperley Bridge, Yeadon Moor, Fool-in-Wharfedale and Pannal, and on arrival at the Grand Hotel an official photograph was taken. The activities of the day were brought to a close by dancing until midnight.

NEEPSEND POWER STATION.

On Thursday, June 2nd, the party left Harrogate by special train for Sheffield, where a visit was paid to the Neepsend power station, which was opened on June 4th, 1904. The present capacity of the station is 78,000 kW, divided among ten machines, some of which are somewhat antiquated. Electrical energy is generated at 11,400 volts, and is conveyed to 130 sub-stations in the city. The tramway current is delivered to seven distribution points, where it is converted from A.C. at 11,400 volts to D.C. at the usual tramway pressure. The boiler-house contains twenty-eight boilers, which generate steam at a pressure of 200 lb. per square inch. Some of the boilers are fitted with oil-burning equipment for use in case of emergency. Although the Neepsend station is not a modern one and does not call for much description, it has played an extremely important part in the electricity supply industry, particularly during the war, when the Allied Forces were largely dependent on the products of Sheffield. According to the returns issued by the Electricity Commissioners this week the thermal efficiency of the station for the year ending December 31st, 1931, was 15·3 per cent., which is not so bad considering the fact that some of the plant is of early origin. The maximum load during the year was 61,000 kW, and the load factor 37·6 per cent.

THE ATLAS AND NORFOLK WORKS.

Luncheon was provided at the Royal Victoria Hotel by the Sheffield Corporation, and afterwards a visit was paid to the Tinsley, Atlas, and Norfolk Works of Thos. Firth and John Brown, Ltd.; but, needless to say, with the time at disposal, the visitors were unable to see everything associated with the manufacturing side of this great concern. Here we cannot do more than give a brief outline of some of the principal departments of the works. At Tinsley the party was shown cogging billets for rolling and forging finished bars of carbon steel and alloy and stainless steels, the processes of examining and chipping billets before re-working, rolling bars in 18in., 12in., 10in., and 8in. mills, rolling sheets in ordinary mild steel, highly finished lagging sheets, and various stainless and Staybrite sheets in different sized mills, including two electrically driven sets of heavy mills having rolls 32 inches in diameter by 5ft. long and designed to roll as standard products sheets up to 10ft. long by 4ft. wide down to a thickness of 20-gauge. Heat treatment, softening, and de-scaling plants, cold rolling mills, and warehouses were also brought to notice. The products of the engineers' tool department of the Atlas and Norfolk Works are too numerous to mention. The plant comprises approximately 300 machine tools, mainly of modern design and specially adapted for the accurate and economical production of small engineers' tools. The department has an up-to-date heat treatment plant with pyrometric control on all the furnaces, and every precaution is taken to ensure a high quality product.

The cold rolling plant comprises equipment for rolling, softening, and de-scaling all qualities of stainless steel strip and is laid out to handle the strips in accordance with the continuous system, which is conducive to the best results. High stainless quality is also assured by the adoption of air cleaning and ventilating plant and the elimination of dirt generally. The plant is capable of turning out strip in all widths up to a maximum of 9in. in all gauges from 14 to 40, although, if necessary, strips thicker than 14-gauge can be produced if required. The operations in manufacture are cold rolling, softening, de-scaling, washing, and inspection, and the sequence of operations is repeated as often as may be required to attain the desired finish and gauge.

The stainless foundry produces miscellaneous castings in rust, acid, and heat-resisting steels; also alloy steel castings for the special and general engineering trades. It is served by a modern high-frequency furnace of 500 lb. capacity. Castings of all qualities can be produced in the heat-treated, de-scaled, and sand-blasted condition, as well as in the rough machined, finish machined, or polished state.

The electric furnaces attracted considerable attention, and were shown in operation. There is an 18-ton arc furnace working at 180 volts and taking 15,000 ampères. It is mechanically charged and produces all qualities of steel, the specifications up to date being well over 300. It is capable of producing at least three casts every twenty-four hours, and working at the lower efficiency the capacity is 28 tons. Four and 8-ton electric furnaces produce all the various qualities of carbon and alloy steels and serve the stainless foundry with steel for casting when required. The furnace department also contains a 1-ton high-frequency furnace similar in design to the 500 lb. high-frequency furnace installed in the stainless foundry. Power for all the furnaces is obtained from the company's own generating station.

Coil springs made of material ¼in. in diameter and upwards, laminated springs for railway and road vehicles, complete buffers, buffer rods and plungers, conveyor screws, coal cutter bars, corf wheels and axles, and disintegrator beaters constitute the chief products of the spring and buffer shop. The great variety of plant contained in this section permits of the production of light miscellaneous forgings and of their machining, and is capable of dealing with the many and varied requirements of the general engineering and allied trades.

In the tire mills the plant consists of slicing machines for parting up ingots into blocks of suitable weight, a continuous furnace for heating these blocks and capable of dealing with 40–50 tons of blocks per eight-hour shift, according to size. Hammers provide cogged cheeses for the rolling mills, which are capable of producing all standard sizes of tires. Besides railway tires, this department can produce rings and hoops from 12in. to 10ft. in diameter and up to 12in. wide and from 1 cwt. to 16 cwt. in weight.

In the Siemens department there are three electric cranes of 25, 100, and 200 tons capacity. Ingots are produced in acid steel only weighing from 15 cwt. to 145 tons. Most of the forging ingots are octagon in section, but ingots of rectangular form may be obtained up to 120 tons in weight from existing armour plate moulds. There are four machine-charged furnaces with capacities ranging from 40 to 60 tons. They work at the rate of fourteen to sixteen hours per cast and produce steel of 0·12 carbon upwards to complex alloy steels. The capacity of the plant is about 50,000 to 60,000 tons per year. Limitations of space will not permit us to deal in detail with the remainder of the Siemens department equipment, which consists, among other things, of a large armour plate mill, hollow rolling plant, two gas-fired furnaces, for heating hollow billets for drum production, two Woods gas machines serving the Siemens furnaces, hollow rolling mill furnace, armour plate mill furnaces and the tire mill furnaces. There are also a 3000-ton press served by two 100-ton electric cranes, and four ordinary re-heating furnaces capable of dealing with ingots of from 20 to 60 tons and producing general forgings of 15 to 45 tons, and a 1200-ton press served by one 30-ton and one 10-ton electric cranes, and five re-heating furnaces. Forgings of 10 to 11 tons can be made at this press from ingots weighing up to 15 tons.

A 10,000-ton slabbing press served by 120-ton and 30-ton electric cranes and four coal-fired bogie furnaces is used for producing the heaviest weight of armour plate slabs required for any warship, the maximum weight being 70 tons. A 2000-ton press is served by 60-ton and 30-ton cranes with electric turn-over gear. Ingots from 10 to 25 tons are dealt with at this press, which is equipped with four ordinary re-heating furnaces and one annealing furnace of the bogie type. Another press associated with the works is a 6000-ton press served by two 200-ton cranes fitted with electric turning-over gear. The plant is capable of dealing with ingots up to 145 tons and of producing solid forgings up to 100 tons and hollow forgings of all descriptions up to 90 tons. The furnaces consist of four ordinary re-heating units, one re-heating bogie furnace, and two bogie annealing furnaces.

In the No. 3 machine shop, which is served by four cranes with capacities ranging from 30 to 120 tons, there are large lathes capable of dealing with forgings and castings up to 90–100 tons and ingots up to 120 tons. There is a full complement of boring machines, planers, and milling machines. The chief products of this department are high-pressure boiler drums, marine cranks, and shafting of all descriptions, turbine shafting, disc wheels, and auxiliary parts, steel castings, &c. Other departments of equal interest, but which cannot be dealt with owing to lack of space, are the East Forge mill, the East Gun Works forge, the East Gun Works machine shops, and the nitriding department, the plant in which having been installed for carrying out the surface hardening of steel by nitrogen.

From an electrical engineer's point of view the most interesting things that were brought to notice were probably the high-pressure boiler drums. In collaboration with Yarrow and Co., Ltd., the firm manufactured in 1925 the first set of forged steel seamless drums for a marine high-pressure boiler and was, it is claimed, the pioneer of this class of work in this country. Since that date the demand for high-pressure drums has greatly increased, and whilst at the outset pressures were comparatively low, the first boiler of the kind being designed for a pressure of 600 lb. per square inch, within the last few months the firm has completed a special alloy steel drum for a working pressure of 2140 lb. per square inch. Since 1925 nearly 700 forged steel seamless boiler drums of various types and sizes have been made, and during 1931, when very large numbers of these drums were required, the output reached one complete drum per day, a rate of production which was maintained for some months. A large drum seen in the works on the occasion of the I.E.E. visit was the last of three made for the Ford motor works at Dagenham. The weight of ingot cast was 156 tons and the finished weight is 62 tons. The diameter inside is 48in., the thickness 5in., the length 45ft. 3in., the test pressure 2150 lb. per square inch, and the working pressure 1400 lb. per square inch. Another interesting product brought to the notice of the visitors was a reaction chamber for the Anglo-Persian Oil Company, tested to a pressure of 3000 lb. At the present time the firm has an order for a reaction chamber which, it is claimed, will be the largest manufactured in this country, the finished weight being in the neighbourhood of 70 tons.

Before the visitors left the works they were provided with tea. In the evening, some members of the party attended a concert at the Harrogate Grand Hotel, whilst others went to the Opera House.

CONCLUSION.

The activities of the party on the last day of the meeting, Friday, June 3rd, call for little comment, since they had no connection with engineering. Briefly, the members journeyed by motor coach to York, where they inspected the Minster. Subsequently some viewed the municipal silver and plate at the Mansion House and paid a visit to the Guildhall, whilst others looked over the Treasurer's house, which is one of the oldest buildings in York and contains a collection of furniture, pictures, and china of historic interest and of great value. It was presented to the National Trust by Mr. Frank Green. Luncheon was served at Joseph Terry's De Grey Rooms in Exhibition-square, and afterwards a visit was paid to Joseph Terry and Sons, Ltd., chocolate works in Bishopthorpe-road, where each member was presented with a box of chocolates. After the visitors had taken tea at the De Grey Rooms as guests of the York Corporation Electricity Committee, they returned to the Grand Hotel, Harrogate, where in the evening there was a reception by the President, Captain J. M. Donalson, and the Chairman of the North Midland Centre, Mr. R. G. Ward, the reception being followed by dancing, light refreshments, and a cabaret.

IN two of the shafts sunk last autumn for the extension of the Boylston-street subway at Boston, Mass., hydrogen sulphide gas was encountered. From the first it caused discomfort to the men by making their eyes water, and it was apparent that the conditions might become unbearable or dangerous. As a remedy, a large galvanised iron pipe was installed in the shaft, with branches that could be run into the tunnel drifts. At the surface the pipe was connected to a motor-driven fan operating as an exhauster. Fresh air then flowed down the open shaft. The method proved satisfactory and kept the work well ventilated.

The Great Western Record.

By HUMPHREY BAKER.

ON Monday, June 6th, two very remarkable runs were made from Swindon to London and back by the up and down "Cheltenham Spa Expresses" of the Great Western Railway. Both these trains have fast regular schedules. The 3.48 p.m. up from Swindon, as is well known, has the quickest start to stop booking in the world—67 minutes for the 77·3 miles, or 69·2 miles per hour—while the 5 p.m. down from Paddington, which does not normally stop at Swindon, is booked to pass there at reduced speed at 6.15—75 minutes from the start.

The up train, as already recorded in THE ENGINEER, made several fast trips last autumn, when the accelerated schedule was first introduced, the best (so far as authentic records are concerned) being that of September 16th, when the run was accomplished in 58 minutes 20 seconds—79·5 m.p.h. The down train had not before then, so far as recorded, ever approached the time of 68 minutes made by the engine "City of Bath" in 1903, when hauling the Royal train from Plymouth *vid* Bristol.

The general standard of locomotive efficiency, however, has risen so greatly since that day that the time was clearly ripe for such performances as those of Monday. Not that this makes those performances any less notable; on the contrary, they are a very remarkable demonstration of the speed capacity of the modern steam locomotive, and of the general efficiency of their equipment and operation which makes it possible to send trains along at such a speed with perfect safety and comfort.

In brief, the 3.48 p.m. train, leaving Swindon punctually, arrived at Paddington on Monday last more than 10 minutes early, in 56 minutes 47 seconds, or at an average of 81·6 m.p.h. throughout, while the down train gained 15 minutes on its somewhat easier timing, and made a special stop at Swindon in 1 second over the hour, or at an average of 77·3.

In view of the unprecedented character of the results and the comparatively short length of the runs, it seems desirable to put the logs on record in considerable detail. Actually, times were taken at nearly twice as many points as are shown, but mainly for checking purposes. It may be mentioned here that the times were noted independently by both the writer and Mr. Cecil J. Allen, each using a split seconds chronograph as well as an ordinary watch, and that their total times agreed to a second in each direction and were confirmed by a third experienced observer who was on the train.

The logs are self-explanatory, but attention may be called to a few points which do not strike the eye at first sight. On the up journey the acceleration was rapid, 50 m.p.h. being attained in 1 mile from the start, 60 in 1¾, 70 in 3¼, and 80 in 5. The time of precisely 48 minutes for the 70 miles between mileposts 72 and 2 from Paddington gives the remarkable average speed of 87·5 m.p.h., while the average of 90 m.p.h. extended over 39 miles and the minimum of 90 over 28, excepting the single mile between posts 44 and 43, where the resistance caused by picking up water from the track troughs momentarily reduced the speed. It is practically certain that no such rates as these have ever before been sustained by a steam locomotive over such a distance; yet it was extraordinarily difficult in the train to realise the speed except by the chronograph readings, the running at the highest velocities being exceptionally smooth.

The actual maximum speed (92·3 m.p.h.) did not create a record, but this could not be expected, in view of the fact that the steepest favourable gradient is only 1 in 754. The maximum was, indeed, attained on the dead level without any assistance from gravity.

In spite of the nominal character of the gradients, the fact that Swindon stands 270ft. higher than Paddington means a definite additional drag on the locomotive through much of the down journey, and in view of this, the performance of "Manorbier Castle" in running from Paddington to Swindon in the hour can hardly be considered less noteworthy than that of "Tregenna." Speeds of over 70 m.p.h. on the down journey through Acton, over 74 through Ealing, and 80 before Southall, are quite unprecedented, as is also such a time as 29 minutes from London to Reading—an average of 74·4 m.p.h. to that point. It is the Didcot-Shrivenham section on which the gradients are most definitely adverse, yet the average rate between those stations was 80·7 m.p.h., and the time of 18 minutes 38 seconds from Didcot to the Swindon stop would have been remarkable even in the other direction.

The "flying" average between mileposts 6 and 76 on this trip was exactly 82 m.p.h., and the maximum—at Slough—86·5.

The sum of the two journey times, 116 minutes 48 seconds, gives an average rate of 79·2 m.p.h. for 154·6 miles—another remarkable figure. Further, the 5.15 p.m. up from Bristol, which is regularly booked to pass Swindon at 6.2 and run thence to Paddington in 73 minutes, was stopped specially to pick up the party from the down train and take them back to London. It thus left Swindon 4 minutes late, and from a standing instead of a flying start, yet reached Paddington 2½ minutes early, in 66 minutes 34 seconds from Swindon, including a slight check at Didcot and a severe one at Reading to the platform road to slip a coach. The total running time for the three trips—232 miles in all—was thus only 183 minutes 22 seconds, or an average of 75·9 m.p.h. throughout.

Records are made to be beaten, but it seems likely that these will stand for a considerable time.

The economic aspect of feats such as these is, of course, of prime importance. Merely as advertisement, Monday's runs may well be justified; but there remains the question of their bearing on express train speeds generally. The Swindon-Paddington stretch is, of course, uniquely suitable for the highest speeds which locomotives can compass, and there are few routes where journey averages of 80 miles an hour are practicable. Nevertheless, it is obvious that on most of our main lines average speeds could be greatly increased without undue strain on the equipment and with increased attractiveness to the public. Improvements already made on the London and North-Eastern, others now announced by the Great Western, and more foreshadowed in other directions, indicate that this view is winning acceptance, and that 60 miles an hour overall is likely soon to become a standard, instead of an exceptional, rate for the highest grade of express. Monday's figures indicate what a margin of power the modern locomotive has for the maintenance of the "mile-a-minute" rate under everyday running conditions.

Log of 3.48 *p.m. Swindon-Paddington, June 6th,* 1932.

Engine No. 5006, "Tregenna Castle."

Driver, H. Ruddock; fireman, H. Thorp, Old Oak Common Shed.

Load, six coaches, 185 tons tare, 195 full. Conditions, fine.

Stations, &c.		Distance, miles.	Time, min. sec. and 5ths.	Speed, m.p.h.
Swindon	Dep.	0·0	0 0/0	—
Milepost 76½	Pass	1·0	2 10/0	27·6
,, 75½	,,	2·0	3 14/3	55·7
,, 74½	,,	3·0	4 8/3	66·6
,, 73½	,,	4·0	4 57/4	73·2
,, 72½	,,	5·0	5 44/3	76·9
Shrivenham	,,	5·7	6 15	—
Milepost 71	,,	6·3	6 40/1	80·9
,, 70	,,	7·3	7 23/4	82·5
,, 69	,,	8·3	8 7/0	83·3
,, 68	,,	9·3	8 50/0	83·7
,, 67	,,	10·3	9 32/2	84·9
Uffington	,,	10·8	9 51	—
Milepost 66	,,	11·3	10 14/3	85·3
,, 65	,,	12·3	10 56/2	86·1
,, 64	,,	13·3	11 37/4	86·9
Challow	,,	13·4	11 42	—
Milepost 63	,,	14·3	12 19/1	86·9
,, 62	,,	15·3	13 0/0	88·2
,, 61	,,	16·3	13 40/4	88·2
Wantage Road	,,	16·9	14 05	—
Milepost 60	,,	17·3	14 21/0	89·5
,, 59	,,	18·3	15 1/0	90·0
,, 58	,,	19·3	15 41/0	90·0
,, 57	,,	20·3	16 21/0	90·0
Steventon	,,	20·8	16 40	—
Milepost 56	,,	21·3	17 1/0	90·0
,, 55	,,	22·3	17 40/4	90·4
,, 54	,,	23·3	18 20/2	90·9
Didcot	,,	24·2	18 55	—
Milepost 53	,,	24·3	18 59/4	91·3
,, 52	,,	25·3	19 39/1	91·3
,, 51	,,	26·3	20 18/3	91·3
,, 50	,,	27·3	20 58/1	90·9
,, 49	,,	28·3	21 37/3	91·3
Cholsey	,,	28·8	21 59	—
Milepost 48	,,	29·3	22 17/0	91·3
,, 47	,,	30·3	22 56/2	91·3
,, 46	,,	31·3	23 35/4	91·3
,, 45	,,	32·3	24 15/0	91·8
Goring	,,	32·6	24 25	—
Milepost 44	,,	33·3	24 54/0	92·3
,, 43	,,	34·3	25 34/2	89·1
,, 42	,,	35·3	26 14/2	90·0
Pangbourne	,,	35·8	26 33	—
Milepost 41	,,	36·3	26 54/1	90·4
,, 40	,,	37·3	27 33/4	90·9
,, 39	,,	38·3	28 13/2	90·9
Tilehurst	,,	38·7	28 28	—
Milepost 38	,,	39·3	28 52/3	91·8
,, 37	,,	40·3	29 31/4	91·8
,, 36	,,	41·3	30 11/0	91·8
Reading	,,	41·3	30 12	—
Milepost 35	,,	42·3	30 50/4	90·4
,, 34	,,	43·3	31 30/3	90·4
,, 33	,,	44·3	32 10/3	90·0
,, 32	,,	45·3	32 50/3	90·0
,, 31 (Twyford)	Pass	46·3	33 31/1	88·6
,, 30	,,	47·3	34 12/0	88·2
,, 29	,,	48·3	34 52/4	88·2
,, 28	,,	49·3	35 34/0	87·3
,, 27	,,	50·3	36 15/2	86·9
,, 26	,,	51·3	36 56/3	87·3
,, 25	,,	52·3	37 38/0	86·9
Maidenhead	,,	53·1	38 08	—
Milepost 24	,,	53·3	38 19/2	86·9
,, 23	,,	54·3	39 1/0	86·5
Taplow	,,	54·8	39 24	—
Milepost 22	,,	55·3	39 42/4	86·1
,, 21	,,	56·3	40 24/2	86·5
,, 20	,,	57·3	41 6/0	86·5
,, 19	,,	58·3	41 47/2	86·9
Slough	,,	58·8	42 10	—
Milepost 18	,,	59·3	42 28/4	86·9
,, 17	,,	60·3	43 10/3	86·1
,, 16	,,	61·3	43 52/4	85·3
,, 15	,,	62·3	44 35/3	84·1
,, 14	,,	63·3	45 18/1	84·5
West Drayton	,,	64·1	45 51	—
Milepost 13	,,	64·3	46 1/1	83·7
,, 12	,,	65·3	46 44/3	82·9
,, 11	,,	66·3	47 28/1	82·5
Hayes	,,	66·4	47 31	—
Milepost 10	,,	67·3	48 12/2	81·4
Southall	,,	68·2	48 51	—
Milepost 9	,,	68·3	48 56/0	82·5
,, 8	,,	69·3	49 39/2	82·9
,, 7	,,	70·3	50 22/1	84·1
,, 6	,,	71·3	51 5/0	84·1
Ealing	,,	71·6	51 17	—
Milepost 5	,,	72·3	51 47/3	84·5
Acton	,,	73·1	52 20	—
Milepost 4	,,	73·3	52 30/2	84·1
,, 3	,,	74·3	53 12/3	85·3
,, 2	,,	75·3	53 56/1	83·3
Westbourne Park	,,	76·0	54 40	—
Paddington	Arr.	77·3	56 47	42·1

Log of 5.0 *p.m. Paddington-Swindon, June 6th,* 1932.

Engine No. 5005, "Manorbier Castle."

Driver, G. Burgess; Fireman, G. Gibson, Old Oak Common shed.

Load, 6 coaches, 190 tons tare, 210 full. Conditions, fine.

Stations, &c.		Distance, miles.	Time, min. sec. and 5ths.	Speed, m.p.h.
Paddington	Dep.	0·0	0 0/0	—
Milepost 1	Pass	1·0	2 14/4	26·6
Westbourne Park	,,	1·3	2 34	—
Milepost 2	,,	2·0	3 30/0	47·8
,, 3	,,	3·0	4 31/1	58·8
,, 4	,,	4·0	5 25/2	66·3
Acton	,,	4·2	5 37	—
Milepost 5	,,	5·0	6 15/3	71·7
Ealing	,,	5·8	6 52	—
Milepost 6	,,	6·0	7 4/0	74·3
,, 7	,,	7·0	7 50/1	77·9
,, 8	,,	8·0	8 36/1	78·2
,, 9	,,	9·0	9 21/0	80·3
Southall	,,	9·1	9 25	—
Milepost 10	,,	10·0	10 5/2	81·0
Hayes	,,	10·9	10 47	—
Milepost 11	,,	11·0	10 49/4	81·0
,, 12	,,	12·0	11 32/4	83·7
,, 13	,,	13·0	12 15/3	84·1
West Drayton	,,	13·2	12 26	—
,, 14	,,	14·0	12 57/3	85·7
,, 15	,,	15·0	13 39/3	85·7
,, 16	,,	16·0	14 21/2	86·1
,, 17	,,	17·0	15 3/1	86·1
,, 18	,,	18·0	15 44/4	86·5
Slough	,,	18·4	16 03	—
Milepost 19	,,	19·0	16 26/3	86·1
,, 20	,,	20·0	17 9/0	84·9
,, 21	,,	21·0	17 52/0	83·7
,, 22	,,	22·0	18 35/0	83·7
Taplow	,,	22·4	18 55	—
Milepost 23	,,	23·0	19 18/3	82·5
,, 24	,,	24·0	20 2/1	82·5
Maidenhead	,,	24·2	20 14	—
Milepost 25	,,	25·0	20 46/0	82·1
,, 26	,,	26·0	21 30/2	81·0
,, 27	,,	27·0	22 15/1	80·3
,, 28	,,	28·0	23 0/3	79·2
,, 29	,,	29·0	23 46/1	78·8
,, 30	,,	30·0	24 31/3	79·2
,, 31 (Twyford)	Pass	31·0	25 17/2	78·5
,, 32	,,	32·0	26 2/4	79·2
,, 33	,,	33·0	26 48/1	79·2
,, 34	,,	34·0	27 33/3	79·2
,, 35	,,	35·0	28 18/1	80·7
Reading	,,	36·0	29 01	—
Milepost 36	,,	36·0	29 2/3	81·0
,, 37	,,	37·0	29 46/0	82·9
,, 38	,,	38·0	30 29/1	83·3
,, 39	,,	39·0	31 12/2	83·3
,, 40	,,	40·0	31 56/2	81·8
,, 41	,,	41·0	32 39/3	83·3
Pangbourne	,,	41·5	33 03	—
Milepost 42	,,	42·0	33 23/0	82·9
,, 43	,,	43·0	34 6/4	82·1
,, 44	,,	44·0	34 50/2	82·5
Goring	,,	44·8	35 24	—
Milepost 45	,,	45·0	35 34/2	81·8
,, 46	,,	46·0	36 17/2	83·7
,, 47	,,	47·0	37 0/2	83·7
,, 48	,,	48·0	37 43/2	83·7
Cholsey	,,	48·4	38 03	—
Milepost 49	,,	49·0	38 26/1	84·1
,, 50	,,	50·0	39 8/4	84·5
,, 51	,,	51·0	39 51/1	84·9
,, 52	,,	52·0	40 33/3	84·9
,, 53	,,	53·0	41 15/4	85·3
Didcot	,,	53·1	41 23	—
Milepost 54	,,	54·0	41 58/2	84·5
,, 55	,,	55·0	42 41/1	84·1
,, 56	,,	56·0	43 24/0	84·1
Steventon	,,	56·5	43 47	—
Milepost 57	,,	57·0	44 7/1	83·3
,, 58	,,	58·0	44 50/4	82·5
,, 59	,,	59·0	45 34/3	82·1
,, 60	,,	60·0	46 18/2	82·1
Wantage Road	,,	60·4	46 35	—
Milepost 61	,,	61·0	47 2/3	81·4
,, 62	,,	62·0	47 47/1	80·7
,, 63	,,	63·0	48 31/4	80·7
Challow	,,	63·9	49 13	—
Milepost 64	,,	64·0	49 16/4	80·0
,, 65	,,	65·0	50 2/2	78·8
,, 66	,,	66·0	50 48/1	78·5
Uffington	,,	66·5	51 13	—
Milepost 67	,,	67·0	51 34/0	78·5
,, 68	,,	68·0	52 20/2	77·5
,, 69	,,	69·0	53 6/4	77·5
,, 70	,,	70·0	53 52/0	79·6
,, 71	,,	71·0	54 36/4	80·3
Shrivenham	,,	71·5	55 03	—
Milepost 72	,,	72·0	55 20/4	81·8
,, 73	,,	73·0	56 5/0	81·4
,, 74	,,	74·0	56 48/1	83·3
,, 75	,,	75·0	57 31/1	83·7
,, 76	,,	76·0	58 15/2	81·4
,, 76½	,,	76·7	58 58/0	63·3
Swindon	Arr.	77·3	60 01	39·2

HIGH-TENSION CABLES.

THE swooping cables sweep across the Downs,
From towering pylons gleaming steely-grey;
"A hateful sight," I hear the high-brow say,
"Appalling offshoot of tumultuous towns!"
My dreary friend, how queerly you do talk!
Why should these cables make your spirit quail?
Are they more dreadful, then, than road or rail,
The old well-trodden path on which you walk?
These ways, by which the townsman goes apart
Awhile from cities' glitter, dust, and smoke,
They also serve to bring the science, art,
And culture of the towns to countryfolk.
These cables serve to make their lives more bright:
They bring to scattered homesteads warmth and light.

I. O. EVANS.

Railway and Road Matters.

IT was announced by Mr. Baldwin on June 2nd that, owing to the amount of essential business which must be passed before Parliament adjourned, it would be impossible to deal with the London Passenger Transport Bill until after the recess.

RAILWAYMEN of all grades will be delighted to hear that in the Birthday Honours Mr. J. H. Fellows is promoted to the rank of Companion of the Victorian Order. Mr. David Davies, who was the chairman of the Cambrian Railway and is a Great Western director, has been made a peer.

WE regret to have to announce the death on May 31st of Mr. C. E. Strange, the chairman of the Railway Signal Company, under whose supervision as signal engineer of the Underground Electric Railways Company, of London, the first track circuit and automatic signals on an electrically operated railway was installed in this country.

As a result of progressive repairs for locomotives, the average time in shops has been reduced on the L.M.S. Railway from 14·84 weeks to 2·37 weeks since 1927. At the same time, mechanical defects to engines in service, involving loss of time, have, since the grouping, been reduced 30 per cent., while the mileage between general repairs has during the past year been increased by nearly 10,000 miles per engine.

THE directors of the Southern Railway have elected Mr. Gerald Loder, the deputy chairman, to succeed the late Brigadier-General Everard Baring as chairman. Mr. Loder was a director of the London, Brighton and South Coast Railway from 1896 until it became part of the Southern Railway, and was its chairman on the death of Mr. Macrae in November, 1922, for the few months that expired before its complete absorption.

THE incident of the tire of an engine breaking and leaving the wheel when near Retford, London and North-Eastern Railway, on Sunday, June 5th, prompts us to remark that, when it is remembered that there are 23,000 locomotives in this country and that they run about 550,000,000 miles a year, it speaks well for the workmanship, material, and maintenance that during the five-year period 1926–1930 a total of only eighty-five such failures was reported.

THE buffer stop collision of March 7th at St. Enoch's Station, Glasgow, L.M.S.R., mentioned herein on March 18th, was inquired into by Colonel Trench, whose report thereon was issued on May 24th. The conclusions of that officer are that the collision must be attributed to an error of judgment by the driver, who, thinking he was going to stop too soon, released his brake after entering the platform, and then deferred his final application until a moment too late.

THE rumours that have been busy of late as to the closing of one of the L.M.S. steel works—at Crewe, or Derby or Horwich—now appear to be based on the fact that that company is no longer to roll its own rails, but to purchase them by contract. It will probably thus be the steel works at Crewe that will be affected. A big shop at Horwich, that has been empty for some time, is being prepared for the repair of electrically operated rolling stock used in the Liverpool and Manchester areas, hitherto done at Newton Heath.

ACCORDING to the *London and North-Eastern Railway Magazine* for June, the first week of the accelerations, from May 1st, in the East Coast Scottish expresses had the following results :—The 10 a.m. from King's Cross arrived in Edinburgh either before or on time on five occasions, and on one day was 5 minutes late. The corresponding up train reached King's Cross either before or on time on each day. The latter report also applied to the 11.15 a.m. from King's Cross—the "Queen of Scots"—but its companion was less fortunate, as it was 2 minutes late on two occasions and 8 minutes late on another.

A REMARKABLE speed record has been achieved during the past two months by the L.M.S. Railway's 4.50 p.m. express from Birmingham (New-street) to London (Euston) which, since April 1st, has been timed to cover the 88¼ miles from Coventry to Willesden in 87 minutes at an average speed of 61·2 m.p.h., this being the fastest start-to-stop express run on the L.M.S. With a train varying in weight from 220 to 275 tons, the arrival at Euston has been punctual on forty-one occasions out of fifty-two; on the remaining eleven days the average late arrival has been 3 minutes, owing to permanent way engineering work having required reductions of speed *en route*.

THE newspapers have reminded us that this month of June sees the seventieth anniversary of what is now the "Royal Scot," *i.e.*, the 10 a.m. from Euston to Glasgow and Edinburgh, and the corresponding up train. These trains have not, however, run continuously nor always left at the hour named. As article No. XIII. in our "One Hundred Years of British Railways," in THE ENGINEER of September 26th, 1924, observed, "Yet another event of interest (in 1862) was the establishment of the 10 a.m. from Euston. That train began to run in June, 1862, and for 54½ years thereafter, on every week-day except during the railway strike of 1911 and the coal strike of 1912, it left at that hour. The restrictions on travel imposed as from January 1st, 1917, spoilt this record as the departure time was altered to 9.30 a.m."

ACCORDING to the Board of Trade returns, the value of the railway material exported during the first four months of the present year was as follows, the corresponding figures for 1931 and 1930 being added in parenthesis :—Locomotives, £157,576 (£790,509, £1,243,573); rails, £113,362 (£452,046, £895,998); carriages, £111,166 (£651,095, £528,624); wagons, £118,270 (£500,583, £979,303); wheels and axles, £48,707 (£75,727, £110,048); tires and axles, £65,334 (£119,922, £231,183); chairs and metal sleepers, £62,890 (£104,077, £279,444); miscellaneous permanent way, £72,102 (£189,029, £288,293); total permanent way, £375,169 (£964,915, £1,846,488). The weight of the rails exported was 12,707 tons (55,227 tons, 103,886 tons) and of the chairs and metal sleepers, 7407 tons (12,679 tons, 29,708 tons). During the month of April last the locomotive exports were of the value of £38,187, of which £13,752 were for India. For the same month the value of the rails sent overseas was £56,783, which included :—British West Africa, £8233; Portuguese East Africa, £3770; and South Africa, £2785.

Notes and Memoranda.

A CONTRACTOR'S wheelbarrow with a capacity of 5 cubic feet is being made in America of aluminium. It weighs 37 lb. and the only piece of steel in its construction is the axle.

A TABLE published in the *Journal* of the National Smoke Abatement Society shows that for the three-year period 1929–31, compared with the period 1926–28, there has been a reduction in total solid deposits of no less than 16·6 per cent. at the eighteen stations covered by the table, and decreases of 24·5 and 18·9 per cent. respectively in the deposits of tar and sulphates (*i.e.*, sulphur acids).

ACCORDING to Mr. C. N. Fletcher, who writes for the *Edgar Allen News*, old types of hacksaws were somewhat slow, but the modern high-speed machine, properly used, is capable of an output some ten to fifty times greater than the old machines. As an example, the oldest type of machine—virtually a hand frame driven by a crank—took from two to three hours, or even longer, to cut a 4in. mild steel bar which a modern machine will cut in five minutes.

THE seventeenth Guthrie Lecture to the Physical Society will be delivered on June 17th next at 5 p.m. at the Imperial College of Science and Technology, South Kensington. Dr. Max Planck (formerly professor in Berlin) is this year's lecturer, and his subject will be "The Concept of Causality in Physics." Professor Planck is famous for his contributions to thermo-dynamical theory and its applications, and above all as the author of the quantum theory.

IT has been suggested that low rates for electric power might permit the use of electric kilns in burning clay products in the Winnipeg area of Canada. Unfortunately, says *The Electrician*, the use of electricity in burning is in its early stages, and while clay products men would like to use electricity, they cannot do so until its use is better understood. The problem in this case in in distributing the heat through the kiln instead of having it concentrated near the elements.

AT a recent meeting of the French Société de l'Industrie Minérale, Mr. Gamière, chief engineer of the Douai mines, described a device used in the Ruhr mines for making more distinct indications of the presence of firedamp by miners' flame lamps. The device consists of placing a borax bead impregnated with sodium chloride in the flame of the lamp at a height of about 7 mm. above the wick. By this means lower percentages of firedamp can be detected than without the bead. The device failed when used in lamps with flat wicks, but was successful in lamps with round wicks.

WITH refrigerating condensers, states a writer in *Power*, there is often a short length of pipe at the coil ends which is alternately wet and dry. This is favourable to rusting and corrosion of the metal. The remedy is to scrape off any rust and clean the pipe from the flange at the header to a point at which the pipe is continually wet. The pipe should then be painted with bitumastic paint over the whole area which has been cleaned. While this paint is still wet a strip of canvas should be wound over the coil spiral fashion. This should be given a coat of bitumastic paint, then a second layer of canvas should be wound over the coil in a similar manner to the first. As soon as the underlying paint is dry the second canvas layer should be painted. This will give effective protection. The paint will effectively seal the canvas to the metal.

A MODEL rolling stand equipped with S K F bearings is being exhibited in Glasgow at the Engineers' Institute. The principal feature of the stand is the simplicity of roll changing and adjustment. The bearings are mounted on a sleeve in an housing, thereby forming a unit which is easily removed from the taper roll-neck. Many rolling stands for both hot and cold rolling have been equipped with S K F spherical roller bearings in recent years, and it is stated that the actual saving in power has exceeded the expectations of the users, the general saving being 40 to 50 per cent., while lubricant saving ranges around 50 per cent. For dealing with radial load a robust bearing is obtained by fitting two bearings on each roll-neck while a further bearing is fitted on each roll for dealing with thrust load where this may be considerable.

THE hydraulic laboratory at McGill University, Montreal, has been greatly enlarged and new equipment has been added, including an experimental turbine with interchangeable runners of the latest types, centrifugal pumps, an experimental pipe line, and other improvements. It is now possible to provide for graduate research investigations where flows of water not greater than 10 cubic feet per second are required; this flow being obtained by re-circulating the water through the laboratory pumps. The engineers of the Back River power development at Montreal used the hydraulic laboratory facilities in making a study of certain problems of that undertaking, and later constructed a small section of the dam at the plant to provide for hydraulic experiments involving the use of much larger quantities of water than are available in the laboratory. The Fraser Brace Company, Ltd., likewise used the improved facilities of the hydraulic laboratory in connection with one of its projects.

A NEW vacuum pressure impregnating equipment suitable for liquid varnish and synthetic resin has been installed recently in the laboratories of the Indian Institute of Science. The plant has been supplied at a cost of about £175 by a French firm, which specialises in the manufacture of impregnating equipment. Impregnation of small transformer coils, small armatures and dielectric materials in small sizes can easily be carried out by this apparatus. It consists of a polymerising stove in which the objects to be impregnated are first dried, at about 100 deg. Cent., the stove being completely evacuated. The hot objects are then placed in a second stove which is initially evacuated. The varnish is then admitted and the vacuum in the stove is replaced by a pressure of about 90 lb. per square inch. The impregnated object is again transferred to the polymerising stove for final drying. All these operations last from about four to eight hours, depending essentially on the nature of the work. This apparatus is expected to satisfy a long-felt need in the laboratories.

Miscellanea.

THE price of mercury is now about £14 nominal per standard bottle of 76 lb.

IT is estimated that an adequate scheme of drainage to prevent flooding in York and Doncaster would cost at least £250,000.

IN about three weeks' time, the racing motor boat, "Miss England III.," with Mr. Kaye Don as a pilot, will make a further attempt on the world's water speed record on Loch Lomond.

THE Exeter Watch Committee has had under consideration the question of the adoption of the electromatic vehicle-actuated street traffic control system, and recommends the installation of the system at Southernhay East–Barnfield-road junction, at a cost of £333.

THE city of Cape Town has adopted a very large scheme of improvements which is to be spread over three years and will cost £1,750,000. Of this amount £500,000 will be spent on the extension and replacement of electrical machinery and £360,000 on sewerage and storm water drainage.

ON Tuesday, June 7th, H.M.S. "Decoy" was launched at the Southampton works of John I. Thornycroft and Co., Ltd., by Mrs. Seely, wife of Major-General J. E. B. Seely, Lord Lieutenant of Hampshire. The vessel is one of the "Acasta" class of destroyers, and has been built under the 1930–31 Naval Estimates.

THE earliest use of mica, states a writer in the *Journal* of the Indian Electrical Engineering Society, was probably in the form of window panes and lantern shields. Mica was in consequence known as "Muscovy glass" (*Vitrum Muscoviticum*), which suggested the name Muscovite, reserved in 1850 by Professor J. D. Dana for the special variety which was then commonly used.

IN order to acquaint themselves with developments in the Chester rural area of supply, the members of the Electricity Committee recently made a tour of some 100 miles, embracing the all-electric kitchens at Eaton Hall, various farms, bakeries, and flour mills, quarries, &c. The Committee was accompanied by Mr. S. E. Britton, city electrical engineer, who explained in detail the equipment and apparatus installed.

THE Birmingham City Council was recently informed that its engineers had not yet succeeded in dealing with a water leakage in the £250,000 reservoir at Bartley Green, notwithstanding that £16,000 had been spent on investigation and repairs. It was stated that if, following further consultations, the engineers were not successful, the attempt to deal with the leak would be abandoned, and the half a million gallons daily wastage would be ignored.

THE Secretary for Mines announces that he has made an Order approving two new types of Cardox carbon dioxide cartridge, types B37 and C (1⅜in. and 2¼in. in diameter respectively) for blasting in coal mines, including mines in which, if explosives are used, they must be permitted explosives. The use of Cardox cartridges, whether of the new types or of the type previously approved (type G, 3in. in diameter), is subject to revised special conditions set out in the new Order.

IT is reported that Professor Piccard has chosen Zürich as the starting point of his second stratosphere ascent. His personal friend, Dr. Tilgenkamp, of the Swiss Air Navigation Association, is coming to fetch the envelope of the balloon from Augsburg, and will take it to Zürich. Professor Piccard will not be ready to ascend until about the middle of July. He has decided to take off between nine and ten o'clock in the morning, when the heat of the sun will give a greater rising power to the balloon by inflating the hydrogen in the envelope.

A REPRINT of the 1911 edition of the Anchors and Chain Cables Act, 1899, as amended in 1928, with the inclusion of the tests for cast steel chain cables prescribed by the Chain Cables Order, 1930, and of tables of maximum charges for these tests, has been issued by the Board of Trade. Additions have also been made to the regulations to be observed in testing in order to bring them into line with existing practice and to provide for the testing of steel cables, Kenter shackles and special links. The new edition is published by H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2, price 1s. net.

BASED upon the knowledge that 40 to 50 per cent. of body heat is radiated towards cold walls, Westinghouse engineers, says the *Electrical World*, have developed a new form of low-temperature panel heating. It is stated that such screens when placed around or near desks or chairs can economically maintain a comfortable range of temperature in mild weather without the necessity of any other form of heating; they also maintain, it is claimed, a comfortable temperature range in extremely cold weather, when outside walls are insufficiently heated by the existing heating system.

THE important structural engineering contract, involving the reconstruction of the Boyne Viaduct of the Great Northern Railway (Ireland) is rapidly nearing completion by the Motherwell Bridge and Engineering Company, Ltd. Thomas M'Donald and Sons, Ltd., Dundalk, were the contractors for the masonry, concrete, and asphalt work. The chief engineer of the railway, Mr. G. B. Howden, has been responsible for the whole work. Reconstruction was begun in June last year, and has been carried out continuously without any serious interruption to traffic. The reconstruction of the three girder spans over the river was necessitated by the railway line adopting heavier rolling stock and higher speeds.

REPLYING to a question in the House of Commons, Mr. Hore-Belisha, Parliamentary Secretary, Board of Trade, said an investigation by the Board of Trade and the Ministry of Labour showed that 123 new undertakings had been established in this country by or with foreign firms between last November and the end of the first week in May. The foreign firms included in this movement were :—German, 65; French, 11; Austrian, 11; Belgian, 9; American, 9; Dutch, 6; and other countries, 12. At the date of the investigation, these new undertakings employed 3882 persons, including 370 foreigners. It was estimated that the figure of 3882 would rise to over 8000 when the factories were fully occupied.

THE THORNHILL POWER STATION OF THE YORKSHIRE ELECTRIC POWER COMPANY

(*For description see page 636.*)

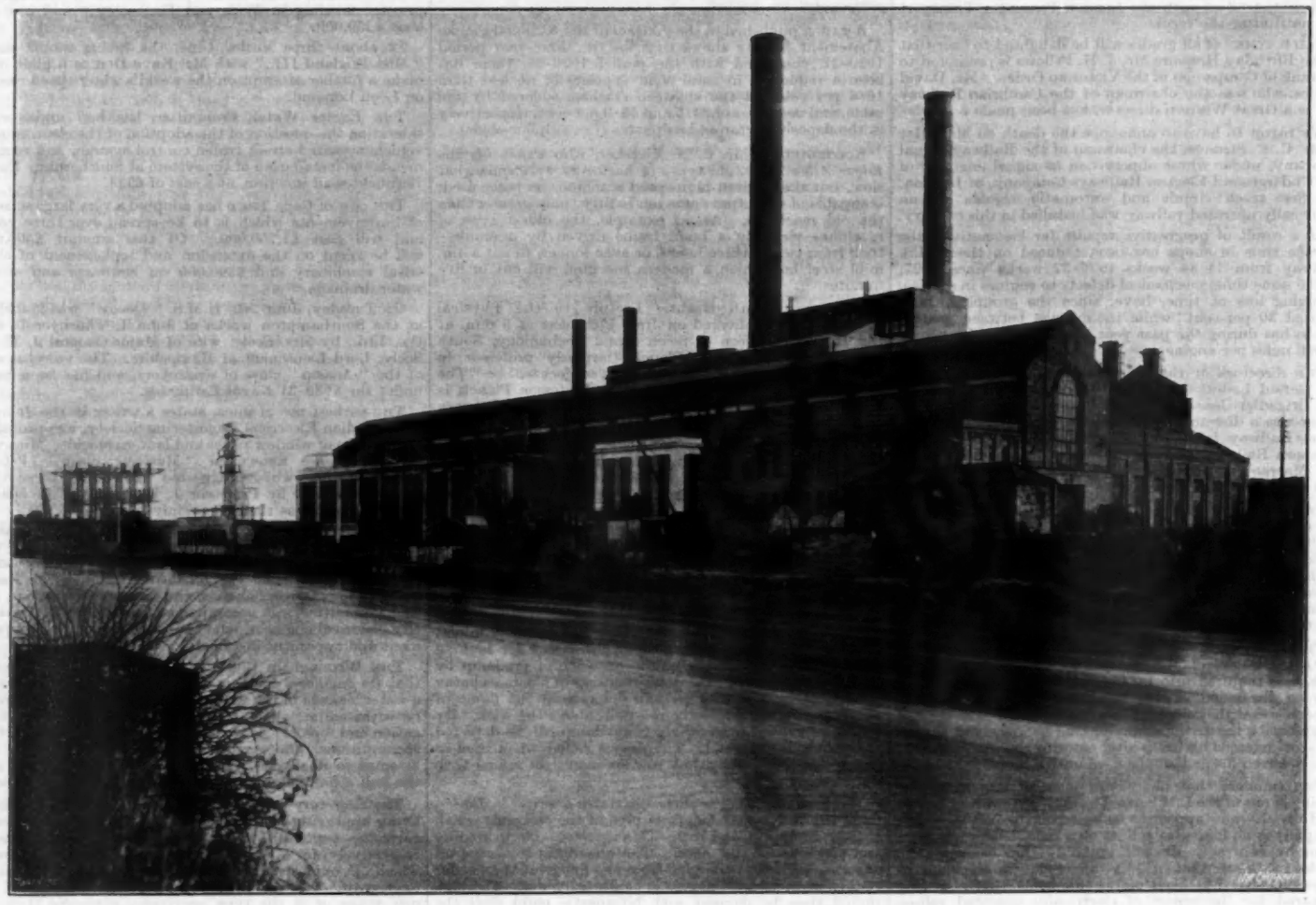


FIG. 7—GENERAL VIEW OF STATION AND "GRID" SUB-STATION

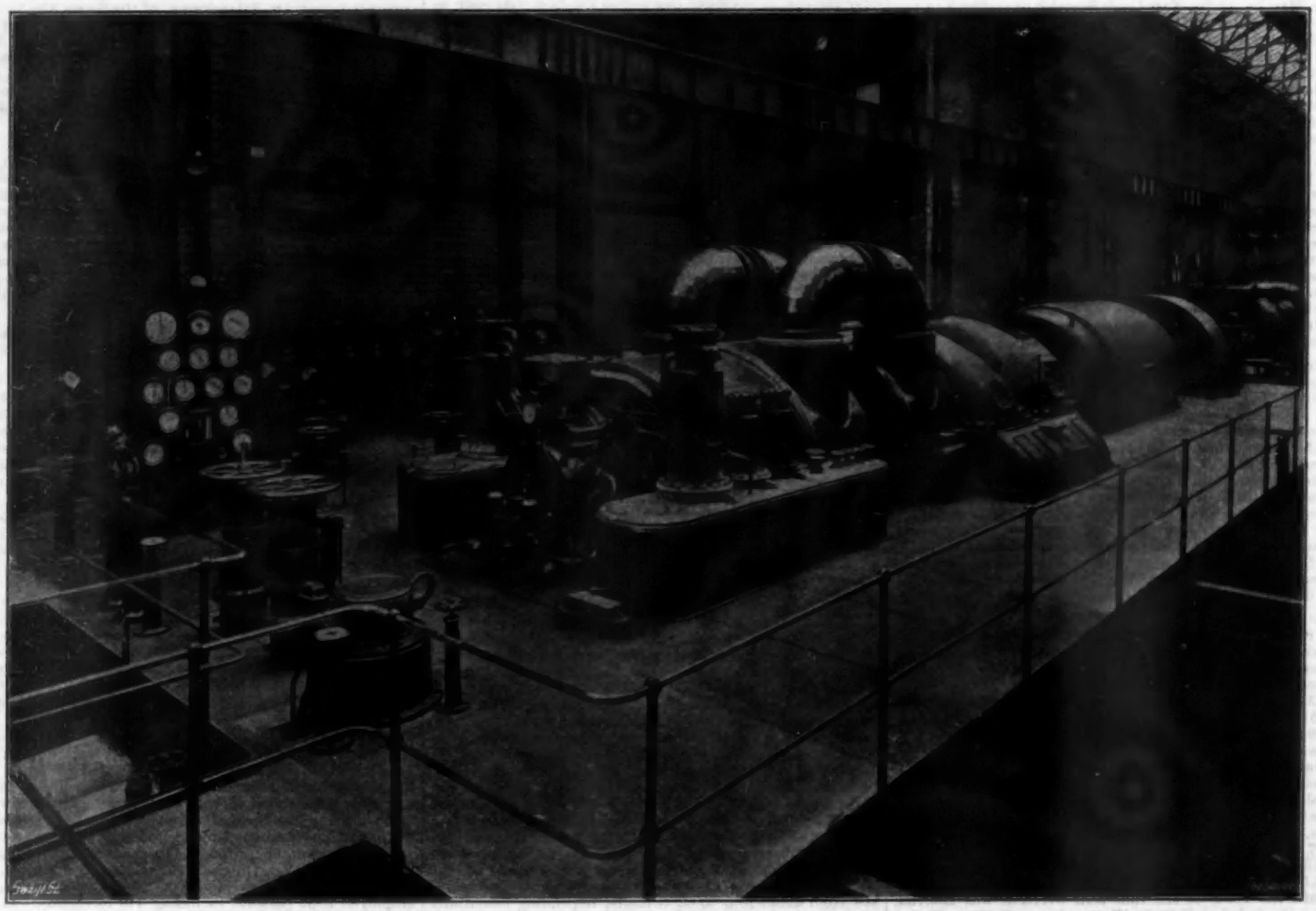


FIG. 8—30,000-kW ENGLISH-ELECTRIC TURBO-GENERATOR SET

The Engineer

JUNE 10, 1932.

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IRON AND STEEL AND THE TARIFF.

AT the end of April the Import Duties Advisory Committee recommended that for three months an additional import duty of 23⅓ per cent., making 33⅓ per cent. in all, should be levied on certain classes of heavy iron and steel products. The Committee foresaw at that time that it would not be possible to formulate a permanent scheme in the few weeks available and provided for the extension of the temporary duty if it seemed desirable. On Friday last a large number of representatives of the iron and steel industry waited upon the Committee, at its invitation, and were addressed by Sir George May, the Chairman. Sir George informed the representatives that the extra duty will not be taken off and that should the present abnormal competition continue the Committee "will not hesitate to recommend a continuance of the present emergency duties for as long as they may prove to be necessary." The continuance is, however, conditional upon the reorganisation and evolution of the iron and steel industry. We are to understand that if it fails to make advances in management and production so that it can provide consumers with "the requisite material of the right quality and at the lowest possible price," the protection on the high scale which now obtains will be removed. That is, at any rate the threat, if we may so call it, implied in Sir George May's terms.

Differences of opinion about the excellence of British iron and steel works have been current for many years. On the one hand we have those who are quite satisfied that the British factories are the best possible for British conditions, and on the other those who are impatient because methods which have proved economical in other countries, Germany and America particularly, are not at once adopted here. The truth no doubt lies, as usual, between the two, and to a certain extent, and in some cases, has been admitted by manufacturers. They have, however, generally defended their position on the ground that what is suitable for other lands is not necessarily suitable for the United Kingdom, and that even if they were convinced of the desirability of adopting foreign methods the conditions of the home industry have been such for many years that the funds necessary for new equipment are not to be found. One of their strongest arguments for a large protective duty was that if only they could preserve the home market against invasion they would soon be in a position to effect such improvements that their power of competing in foreign markets would be strengthened. Sir George May has taken them at their word. He is, clearly, amongst those who are not satisfied that the British iron and steel industry is the best possible for British conditions, and he takes the view that if a high protective duty does not enable the industry to improve itself, then such a tariff is worse than useless and is better off than on. From that view we, at any rate, shall not dissent. There are many who hold that even if it were shown that no changes of moment could be made in the British industry, yet the importation of foreign iron and steel should be debarred or made extremely difficult. It is manifest that Sir George May and his Committee do not subscribe to that opinion. It is implied by the conditions laid down by them that unless reforms that would effect a material reduction in the price of iron and steel in the home market can be effected, then the emergency tariff of 23⅓ per cent. will be removed and the industry will have the enjoyment of no more than the general duty of 10 per cent. on all imported goods. By the statement of those conditions Sir George has given an effective answer to those who contended that a high tariff would be a cloak for inefficiency. We never anticipated that result; for the good reason, which events of the past few months have made evident, that despite the tariff foreign steel would still enter the British market and undersell the home product at its present price. The key to the regeneration of the industry is not so much the adoption of means which must eventually increase the price of imported steel, but the reduction of the home price to a level at which permanent foreign competition is not to be feared. That cannot be effected by anything that the industry can do alone. The provision of the most up-to-date plant under the sun and internal reorganisation of the most searching kind will fail to bring our costs down to those of Continental competitors, whom we alone have to fear, as long as every ton of iron and steel is burdened with a load of taxation many times greater than that borne by our rivals. When Sir George is considering the decreases in cost of manufacture which steel masters can effect by the re-equipment of works and by wise rationalisation we trust that he will not forget that the State can also play a part in the reduction of costs. The local rates on steel and iron have, indeed, been reduced to about a quarter of what they were, but the load borne by every ton for social services is still not far short of six shillings.

The means by which Sir George May's Committee proposes to effect the object in view are peculiar and, we believe, unexampled in British industry. The description of them is best given in the Committee's own words:—"The Committee have no desire to dictate to the industry what the general lines of evolution should be; the industry itself must work out its own plans, but the Committee will not hesitate to criticise those plans in respect of their adequacy to meet the emergency with which the country's trade is faced. The Committee has therefore decided to constitute a national committee to work out appropriate schemes with district sub-committees and a small executive committee. There will also be certain small committees for specialised sections of the industry. It is essential that each section should review the branch of the industry falling within its purview, not only from the point of view of meeting foreign competition with its products in this country, with the aid of a reasonable measure of protection, but also with the definite object in view of supplying British users of iron and steel at a price and quality that will enable them, in turn, to sell their products in the markets of the world." Mr. Charles Mitchell, chairman and managing director of Dorman, Long and Co., Ltd., has accepted the chairmanship of the National Committee, with Sir William Larke, Director of the National Federation of Iron and Steel Manufacturers, as secretary. This arrangement is, as we have said, peculiar and unexampled, and we say with little hesitation that if it were not for the stress of circumstances it would be resented by the industry. For it comes to this that a Government Committee sets itself up as an arbiter of the management of our iron and steel factories. It is in the position to say: "Do what this Committee approves or go without protection." However earnest one may be in a desire to see improvements effected, it is impossible not to feel some qualms about this further example of State intermeddling with private concerns. It may be the thin end of a wedge. Iron and steel do not stand alone in their request for high protection. Are we to understand that the Import Duties Advisory Committee proposes to extend this principle to other industries? Logically it might do so, and in the course of time we should reach the very undesirable condition that the Government, through a Committee, could control many of the manufactures in the country by a threat of removing a protective tariff. That policy would commend itself to the Socialists; we do not believe that the present House of Commons would tolerate it, and we may trust, therefore, that the principle will not be extended. The iron and steel industry has accepted it because beggars cannot be choosers. It is to be hoped and expected that under the wise management of the National Committee "appropriate schemes" will be calmly worked out, but we must admit some anxiety about the issue, and still more about the introduction of a new principle in the relationship between industry and the State.

Railway Speeds.

IN June, 1905, Mr. Rous-Marten, the greatest recorder of railway speeds that has ever lived, wrote to Mr. (afterwards Sir) James Inglis a letter which did not see the light of publicity for seventeen years. It was kept back from fear that if the facts about railway speeds were known passengers would be scared. Nowadays travellers clamour for speed rather than deprecate it, and such an achievement as that noted by Mr. Rous-Marten would be hailed triumphantly as a "New Record," and would escape the contemporary critical adjectives "terrific" and "dangerous." The letter, which may be found in our issue of November 17th, 1922, is of particular interest at the present moment, when the great speeds reached by the "Cheltenham Flyer"—see page 638—are attracting general attention, for the trip which Mr. Rous-Marten timed was made between Plymouth and London, and included, of course, the Swindon–Paddington stretch on which the tests were made last Monday. The date was sometime in May, 1904, and the train the "Record Mail Special." It averaged 70·2 m.p.h. from the Exeter "slow pass" to the Bristol stop, and 71·5 from the Bristol start to the Paddington stop, notwithstanding certain delays. Between Swindon and Paddington a steady average of 80 miles per hour was maintained for 73 miles on end. It is worth quoting a sentence in full from this "confidential" letter. "What happened was this: When we topped the Whiteball Summit, we were still doing 63 miles an hour; when we emerged from the Whiteball Tunnel we had reached 80; thenceforward our velocity rapidly and steadily increased, the quarter miles times diminishing from 11 sec. at the tunnel entrance to 10·6 sec., 10·2 sec., 10 sec., 9·8 sec., 9·4 sec., 9·2 sec., and finally to 8·8 sec., this last being equivalent to a rate of 102·3 miles an hour. The two quickest quarters thus occupied exactly 18 sec. for the half mile, equal to 100 miles per hour. At this time the travelling was so curiously smooth that, but for the sound, it was difficult to believe we were moving at all." Whiteball Summit and Tunnel lie about 4 miles from Wellington.

Whilst it is possible that Mr. Rous-Marten may have been fortunate enough to strike a remarkable run, it is probable that the speeds attained for short distances were not unexampled. Unfortunately, he does not give the weight of the train, but it was certainly much lighter than those which ordinarily make the same run to-day. The point of interest is, as railwaymen well know, that extremely high speeds are, and always have been, attainable on railways, given the right conditions. The locomotive itself has been capable of them anywhere within the last sixty years and more, but they cannot be used economically with long and heavy trains. It is not only that the weight diminishes the average speed over an undulating line, nor that the total mechanical resistance is increased. The air resistance goes up, too, as the train gets longer and faster, and is, in fact, the last straw in an accumulation of opposing forces. The Great Western showed on Monday what can be done on a favourable length of road—Brunel laid it out for speed—even with trains weighing about 200 tons, but it would be very wrong to conclude that it indicates the possibility of effecting a general increase of express average speeds up to eighty or even seventy miles an hour. The passenger asks for a great deal nowadays, and in supplying it the weight of rolling stock is augmented. If he were content

with what satisfied his grandfather, or if means of materially lightening carriage stock is found, then a general large acceleration may follow, but in the present circumstances it may be taken that the average speeds are approaching the economic summit.

A notable fact in connection with the admirable runs of Monday last is that they were made by the same railway which achieved the record described by Mr. Rous-Marten twenty-eight years ago, and that they do not show a very striking superiority to the old run. There will not be wanting critics who regard that fact as an indication that the steam locomotive has made no progress, or that railways are not taking full advantage of its capacity . To that the reply is that high speeds are very costly, and that the railways are justified in adopting those which, all things considered, are the most economical. It may be that studies which are now being made on the air resistance of trains, combined with advances in metallurgy that may enable a material lightening of rolling stock to be effected, will result in means being found for reducing the total resistance of train, and that then the point of maximum economy may be raised. But until that is accomplished, and as long as the public expects the provision of the magnificent express coaches which are found on British railways to-day, it is improbable that locomotives will be run up to the full speed capacity of which they have been capable, as shown by the records, for many years past.

The Institution of Civil Engineers.

ANNUAL CONVERSAZIONE.

THE annual conversazione of the Institution of Civil Engineers was held on Wednesday evening at the Institution's house in Great George-street, London. As usual, it was attended by a large number of members and their friends and, also in accordance with custom, the halls and stairways of the building were for the occasion transformed by the horticulturist's art into bowers of exquisite beauty.

The members and guests were received in the Great Hall by Sir Cyril and Lady Kirkpatrick and the Council of the Institution, and subsequently were entertained by the music of the band of the Royal Air Force and by vocal and instrumental concerts. During the evening three short lectures were delivered —one by Mr. Ralph Freeman, on "Sydney Harbour Bridge;" another by Wing Commander A. H. Orlebar, on "The Schneider Trophy Contests and the Value of High-speed Flying;" and the third by Dr. G. W. C. Kaye, on "Noise."

The exhibition of engineering and scientific objects of interest in the Library was more than usually a display of models. Of all the exhibits none excelled in attraction that of Professor E. G. Coker, who demonstrated by his well-known photo-elastic methods the varying stress in a driving wheel of a "Royal Scot" locomotive. The model wheel, made of transparent celluloid, was rotated in contact with another wheel representing the rail and, in a beam of circularly polarised light, showed the manner in which the stresses varied in the tire, rim, spokes and balance weight as the wheel turned. We reproduce herewith a photograph which will give some idea of the distribution, although much is naturally lost by the absence of the colours. The wheel was built to scale, the tire shrunk on and the crank axle and pin forced in. These operations produced a considerable initial stress in all parts of the wheel, which could easily be observed before the load was applied. The varied movements of the colour bands when the wheel is rotated enable the behaviour of the wheel under load to be studied, and a large number of measurements have already been made. Some of the salient features are visible in the photograph, as, for example, in the tire, in which, opposite each spoke, a colour band appears, denoting a local increase of stress in the rim at these places. In the wheel centre there are also well-marked black points or patches in its rim opposite the ends of all the long spokes. The stress intensity appears to be low at all these latter places, which are therefore very suitable for the reception of tire fastening devices. Some interesting stresses are also found at the junctions of the spokes with the balance weight, and also around the crank pin and axle. The experiment convincingly demonstrated how numerous and intricate are the problems associated with the running of a wheel on a rail.

Professor C. E. Inglis demonstrated the action of a simple device for damping the vibration of bridges and other structures. The experimental apparatus employed for the purpose of the demonstration made use of a steel bar ⅜in. thick and 2in. wide, which was freely supported at two points about 5ft. apart. An out-of-balance wheel was mounted on top of the bar at its mid-point and was driven through a flexible shaft by a small electric motor. At a certain speed the running of the out-of-balance wheel caused the bar to vibrate through a total amplitude of about ½in. as measured at its centre. The vibration damper consisted of a mass representing about 1 per cent. of the mass of the bar, which was attached to springs mounted on the underside of the bar. A hydraulic dashpot arrangement was associated with the damping mass. When the damping device was thrown into action the vibration of the bar ceased quickly and all the energy of the vibrating influence was transferred to the damping mass and was absorbed in the dashpot. The fundamental principle of the device is similar to that involved in the known means for eliminating the torsional oscillations of crank shafts. It is also exemplified in the Frahm anti-rolling tanks for stabilising ships.

Mr. J. H. Walker showed some models illustrating the control of cracking in concrete roads, pavements, and walls. The object of Mr. Walker's system is to enable roads and walls to be built without expansion joints and at the same time be made immune from visible cracks or warping. The principle of the system is the inoculation of the concrete with innumerable minute cracks or planes of weakness. Plain concrete uncontrolled by outside forces contracts towards the centre of its mass. If, however, it be interlarded with "plums" it will split up into numerous small masses, each of which will shrink towards its own centre of mass. In Mr. Walker's system the plums are steel hoops of circular or hexagonal shape, 24in. in diameter and 2in. deep, which are pressed into the concrete before the final layer is added. These steel hoops fill the concrete with a large number of invisible cracks and render it immune from visible cracks and warping. The only joints which need be made in the concrete are those corresponding to the end of a day's work.

Professor S. M. Dixon exhibited an ultra-micrometer strain gauge constructed for measuring the kinetic stresses in colliery winding ropes in connection with the investigations of the Wire Ropes Research Committee of the Safety in Mines Research Board. The stresses are deduced from measurements

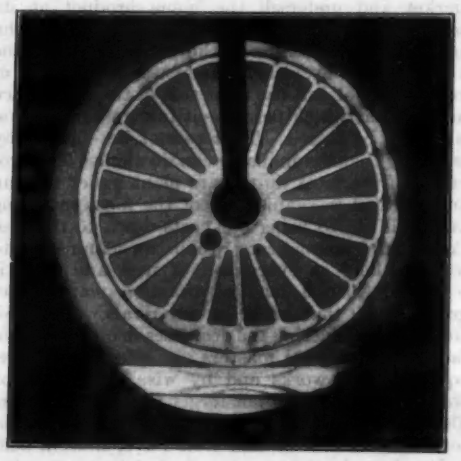


PHOTO-ELASTIC IMAGE OF LOCOMOTIVE WHEEL

of the strain in a 2in. diameter steel bar made with the ultramicrometer gauge. The circuit used is that of Mr. J. J. Dowling, in which the change in distance between the plates of a condenser is used to modify an oscillating circuit comprising suitable coils and a micrometer valve. Within certain limits the relation between movement of the condenser plates and the anode current of the valve is linear, and the anode current can be taken as a measure of the separation of the condenser plates or of the strain on the 2in. bar. To enable the phenomena to be recorded the anode current is amplified by means of a single-stage direct-resistance type of amplifier with grid bias battery and passed through an oscillograph. Means are provided for switching the 4-volt lamp of the oscillograph on and off automatically so that overlapping of records on the drum is avoided. Time marks are made on the record at half-second intervals by means of a spark from an induction coil. Tests have been carried out at a colliery in the Midlands during coal winding, and the records of the strain gauge compared with those of an accelerometer. It has been found that there is satisfactory agreement between the rope stresses measured with the strain gauge and those deduced from the record of the acceleration of the cage. Consequently the accelerometer, which is a simpler and more portable instrument, can be used with confidence in future investigations of colliery winding conditions.

A fatigue testing machine for wire was also shown by Professor Dixon. This machine has been developed for testing the fatigue resistance of hard-drawn steel wire such as is used for colliery winding ropes. The investigation of the relations between the mechanical properties, microstructure, and fatigue resistance of hard-drawn wire forms part of the programme of the Wire Ropes Research Committee of the Safety in Mines Research Board. The test is carried out by causing the specimen of wire to vibrate as a "free free" bar, with two nodes approximately 0·22 of the length from each end. In this way the specimen is subjected to reversed bending, the bending moment varying from a maximum at the centre to zero at the nodes. Knowing the modulus of elasticity, the stress can be calculated from the amplitude of vibration, and thus it is possible to subject a specimen to any desired stress by controlling the amplitude. This method of test has the great advantage that the most highly stressed portion of the specimen is not restrained or gripped in any way. The specimen is supported at the nodes by loops of copper wire and is placed between the poles of a pair of permanent magnets. Alternating electrical impulses in synchronism with the natural period of vibration are passed through the portion of the specimen between the nodes, which portion is caused to vibrate by the interaction of the alternating current in the wire with the unidirectional flux between the poles of the magnets. A beam of light from an electric lamp falling on a light-sensitive cell is periodically occulted by a small flag attached to one of the projecting ends of the specimen. The impulses from the cell in response to the occultations are amplified and passed through a transformer to produce a large current at low voltage, which is led through the specimen. The vibrations are counted by means of an electric clock which is placed in circuit with the amplifier.

Sir Robert Hadfield exhibited a collection of seventeenth century mining tools recovered from old lead mine workings in Durham. The mines date from about 1634. Two of the tools were hand jumpers for drilling holes. Examination showed that the tools were composed of two materials of high and low carbon content. It is surmised that the iron was probably smelted in the old way by the use of wood charcoal and was welded to similar iron which had been carbonised by cementation, a process which dates back to ancient times. Other exhibits shown by Sir Robert were the now famous collection of Faraday's alloys of steel, an improved type of Chevenard differential dilatometer which autographically records changes in the dimensions of a specimen of metal at different temperatures, and a series of diagrams, photographs, and samples illustrating some recent practical applications of special alloy steels. The phenomenon known as corrosion brittleness was the subject of another of Sir Robert's exhibits. Non-corrodible steel containing 18 per cent. of chromium and 8 per cent. of nickel is liable to undergo a change when exposed to temperatures between 450 deg. Cent. and about 800 deg. Cent. This change results in its becoming much less resistant to corrosion, and such corrosion renders the steel quite brittle. This phenomenon of corrosion brittleness is of importance in the case of welded joints, the condition known as weld decay being identifiable with corrosion brittleness. Specimens were exhibited showing the effect of additions of silicon, titanium, tungsten, and vanadium on the liability of non-corrodible steel to corrosion brittleness. Tungsten appears to be quite ineffective. Vanadium in the proportion of 1 per cent. limits the temperature range within which the defect is produced. Titanium, it would seem, completely prevents the incidence of corrosion brittleness.

Mr. Sherard Cowper-Coles exhibited specimens of metallic mirrors made by electro-deposition and showed a drawing and model of the plant used for the manufacture of parabolic mirrors. Samples were shown of parabolic mirrors faced with chromium and with rhodium. One such mirror was exhibited after it had been made a target for rifle shots. It was noticeable that the bullets had passed through the mirror without doing more than local damage to it.

Mr. John L. Hodgson showed a collection of instruments for controlling the flow, temperature, and pressure of air and for recording air velocities down to ¼ft. per second. He also exhibited a pressure-operated master boiler controller.

Mr. A. Woodroffe Manton exhibited a geological model of the proposed London underground goods railway, a £40,000,000 scheme designed to provide the Metropolis with about 100 track miles of underground railway connecting up all the surface railway goods marshalling yards and, separately therefrom, an internal system for express parcel traffic serving the larger centres of distribution. Adjacent to this exhibit a model was shown of a mechanical excavator suitable for the construction of a tunnel 16ft. 9in. in diameter in London clay or chalk or similar strata. This machine is designed for continuous operation, as distinct from the intermittent operation of the usual tunnelling machine. The excavating head carrying the digging tools or knives can be advanced independently of the shield framework. The pressure on the excavating head is controlled by a single ram, the pressure on which is regulated by an electrical relay circuit from the current flow to the main electric motors which rotate the head. In this way the pressure on the head is maintained at the correct value under all conditions of working. The weight of the shield and the pressure from the surrounding ground produce sufficient friction to maintain the position of the shield while the main rams are withdrawn, and a new ring of lining may therefore be erected while the head continues at work. A third exhibit shown by Mr. Manton was a model of a new design of tunnel lining constructed entirely of rolled steel sections with forged steel jointings without welding.

The National Physical Laboratory's exhibits included the series of photographs recently shown at the Royal Society's conversazione illustrating the technical application of X-ray crystal analysis. The Laboratory also showed an optical projection method

for testing the accuracy of metal gauze used in sieves, a high-temperature extensometer for measuring rates of creep of the order of 10^{-6}in. per inch per hour, a high-pressure tilting manometer for measuring very small pressure differences and apparatus for testing the sensitivity of "level" tubes.

Literature.

Honest Doubt: Being a Collection of Papers on The Price of Modern Politics. By ERNEST J. P. BENN. London: Ernest Benn, Ltd. 1932. Price 6s.

THE first comment of all who read this book—and may they be numbered by thousands—will assuredly be that the author has no "doubts" whatever. He does not advance his opinions with hesitation or reservations. He does not concern himself with careful analysis of motives and principles; there is nothing subtle about his method. He cares not a pin for hypothetical methods of improving the lot of mankind. Facts and results alone interest him. He hurls them at the midrifs of his opponent without the slightest particle of doubt that they must reach their aim and without deeming it advisable to spend a moment's thought on the possibility of an effective riposte. It is that that makes this book such good reading.

We need hardly say that it is stoutly individualistic. Everyone knows that Sir Ernest Benn is the champion of individualism and that he is at his best and brightest when he is in the lists like a modern Orlando Furioso, carrying off half-a-dozen rationalised companies, spitted like quails, upon his single lance. But if we wanted to pick a label for these essays we should select "Give us back our Liberty" as the most completely descriptive. For the current of thought that runs through it from cover to cover is that there is too much interference by those set in authority. A few quotations will show at one and the same time the author's views and the directness of his style. "We must," he writes in an essay on Public Life, "get our public life back to the liberty level, and then it will begin to attract more persons with the mentality of statesmen. At the moment it has sunk to a scheme for occupying busy-bodies and pauperising the rest of mankind." And again in the same essay, "When our public men were our leaders, they strove to find us liberty. Now they look upon themselves as our masters, and are day by day filching more and more liberty from us." Or this from a chapter entitled "Political Money." "The main lines of our national policy during the next few years must therefore be a fixed determination to get our money back into the hands of the people and out of the hands of the politicians." So we might go on picking up sentences here and there, all drawing towards the same conclusion that the ills which we are suffering are due to the extension of the acquisition of power by the State and the loss of the individual's liberty to use his money and his brains as he thinks best. Those who read "Account Rendered" need not be told that Sir Ernest Benn is brave enough to look back to Victorian days with respect. In this volume he contrasts the liberty, individualism, and success of that Augustan age with the political slavery, Socialism, and industrial and economic failure of the present. We suspect that in his copy of Gibbon the following sentence is heavily scored: "The subjects of Constantine were incapable of discerning the decline of genius and manly virtue, which so far degraded them below the dignity of their ancestors; but they could feel and lament the age of Tyranny, the relaxation of discipline, and the increase of taxes."

We have perhaps said enough to show our readers the nature of "Honest Doubt," and we hope enough to make them read it. But we cannot refrain from setting down a few sentences, some of them aphorisms, which we ticked as we turned the pages. Here they are:—"All parties acted in sublime ignorance of the elementary economic truth that profit is only a commission on economy." "Until the last farthing of reparation is expunged from the states of the world, any talk of getting back to normal, useful commerce is impossible." Here is an intriguing tale of taxation. "Imagine an undertaking requiring the services of a wealthy expert, services for which the appropriate fee would be £1000. As matters are arranged to-day a fee of £1000 to such a person amounts in practice to a payment of £4 a year. It works out in this simple way. A £1000 fee, when income tax and surtax have been deducted, amounts to £450. The wealthy expert then invests the £450 at, say, 4 per cent., giving him a return of £18 per annum. But the £18 is subject to income tax and surtax, and by the time it reaches his domestic account has thus dwindled to £8. Later the man dies, and no wonder. Death duties and estate duties halve the account, and £4 a year is left." Writing of the quondam financial position of this country when "the bill on London was the commonest international instrument, the pound sterling the usual currency of commerce everywhere," and that as a result "we enjoyed the advantage of the deposits of the world," Sir Ernest exclaims, "Imagine the effect upon the mind and confidence of depositors of the political happenings of recent years. When the world awakened to the fact that we were borrowing to pay the dole, the world asked where the money came from, and drew the conclusion that it might be derived from some of these deposits," but when "funds are being used for improper purposes, then the depositor begins to ask for his money back." "Can it be supposed," the author asks in another place, "that the South American or the Far Eastern will continue to put his money in London if he thinks that from time to time that money is to be exposed to all the experimental risks associated with new-fangled economic theories?" Here are two more scraps: "There is talk of a conference—conference having in the modern world completely superseded right, wrong, precept, and practice." "As the catalogue of the follies of rationalisation of industry grows longer, we are slowly beginning to understand that there is a point in every scheme of things at which organisation becomes an expense rather than an economy, a hindrance rather than a facility. The same obvious truth has yet to be appreciated in our public life."

Sir Ernest, as we have seen, contemns conferences. He has no more respect for committees. "When we get sane public opinion we shall award knighthoods to chairmen who succeed in dissolving committees." His individualism leads him still further; he hates planning, too. "We must no doubt have our plans," he writes, "just as we have our prisons, our hangmen, our navies, and our armies, but do not let us be foolish enough to imagine that these things are desirable in themselves. They are at their best nothing but necessary evils."

Just as at the cinema you may see little scraps from the films which are "Coming Next Week" in order to excite your interest, we have here placed snippets, culled at random, but with some method, from "Honest Doubt," in the hope that the samples may induce others to read a volume which has given us great pleasure. That many will differ from Sir Ernest goes without saying. That his directness of style makes things look too easy cannot be doubted. But disagree or question as you may, you can hardly fail to find pleasure in a book which reflects the things that are dearest to all Englishmen: real liberty and the right to do what one wills with one's own.

Surveying from Air Photographs. By Captain M. HOTINE, R.E. London: Constable and Co., Ltd. 30s.

THE art of surveying is very closely connected with means of transport. Every improvement in man's devices for moving himself and the products of his hands has been reflected in an increasedly accurate knowledge of the arrangement of land and sea on the surface of the earth. When man utilised the wind to cross the oceans in wooden ships and moved about the country on horse-back, or—with hardly less fatigue—rode in a coach, it was not to be expected that his map-making of the less habitable portions of the globe would be very accurate. Less than half a century ago there were large blank spaces on every map of the world—spaces which an earlier generation would have filled with pictures of dragons or sketches of mermaids, elephants and sunken ships. The railway and the motor car opened up parts inaccessible to any-but isolated explorers, and necessitated a survey of the country through which they passed.

By the end of last century the blank portions on the map were relatively small disconnected areas. Nevertheless, enormous tracts had been but partially surveyed, and only general conclusions as to the configuration of the land were available. Many such areas will possibly remain unsurveyed for ever, owing to their lack of value to mankind; but the accurate survey of many others had only been delayed by the difficulty and the expense of carrying it out. The aeroplane has made the survey of such tracts possible. The accuracy of delineation obtained by aerial survey may not be so great as that required for the map of Europe, but it is at least sufficient when the nature of the country concerned is taken into consideration. If the aerial survey is combined with a rapid ground survey, the accuracy is at least comparable with that of a complete survey from the ground alone. The making of a map may, however, be quite subsidiary to the main undertaking. In Canada, for instance, aerial survey is much employed in connection with forestry. From the air the extent and, to some degree, the value of a forest can be judged far more easily, and usually at less expense than from the ground. For such a purpose it is only necessary to take sufficient measurements to define the extent of the selected area and to fix its position. Surveying such a district from the ground would be a long and arduous process. The fact that surveying is not necessarily the same as map-making is stressed by the author of the present work, who, referring to a dictionary definition, states that "Measurement is considered as a means to an end and not as an end in itself, and no insistence is placed on the necessity for any measurement at all if the map or detailed description can be compiled without it."

Surveying from the air is practically a new subject. It depended for its success on the development of suitable aircraft and of means of taking accurate photographs from the air. Even now, when very considerable tracts of country in all parts of the world have been surveyed in this way, comparatively few people have anything more than a vague conception of how it is done, or of the difficulties involved. Captain Hotine's book, however, will not satisfy the multitude. It is intended, we imagine, for the use of those who are already concerned directly with aerial surveying, or are likely to be in the future. It is too encyclopædic to appeal to those whose interest in the subject is that of the dilettante. The author was, for five years, the Research Officer of the British Air Survey Committee, and it is largely due to the fact that he has discovered and initiated simple methods that air surveying has become a practicable alternative to surveying on the ground. He is, therefore, well qualified to write on the subject. While he leaves no doubt in the mind of the reader as to his enthusiasm, he is not afraid to demolish many of the foolish and extravagant claims that have been made for aerial survey, and he clears up many of the misconceptions that have grown up as to the applicability of the method. Throughout the book he is careful to emphasise the limitations of aerial surveying and to show that it is not by any means necessarily complete in itself.

There is, we think, no need for us to name the various subjects with which the author deals. It is sufficient to say that we can call to mind no other book which covers the ground so fully. The needs of both the student and the practising engineer are met in a volume that is well printed and adequately illustrated. Captain Hotine's is likely, we think, to be the recognised text-book on the subject for some years to come.

SHORT NOTICES.

Romances of London's Underground. By W. J. Passingham. London: Sampson Low, Marston and Co., Ltd. 1932. Price 12s. 6d. net.—London's underground is probably one of the most complicated railway systems in the world, and Mr. Passingham has been successful in giving an explicit and yet simple description of a difficult subject. The book opens with an account of the beginning of London's traffic problem, its growth, and the fight against public opinion of Charles Pearson, the City solicitor, who, as the founder of the North Metropolitan Railway Company in 1854, was the originator of the underground system of railway travel. Charles Pearson's system was in reality a series of long tunnels, and the author reminds us that the first tubular railway was built between the Tower and Bermondsey by Peter Barlow, who, with his assistant, G. H. Greathead, used the tunnel shield for the first time. In this tube ran a twelve-passenger car. Thus the City and South London Railway was not, as is commonly supposed, the earliest tube railway in London, though it was the first to be electrically operated. A chapter is devoted to Piccadilly Circus Station, and much of interest will be found in the description of the power stations at Neasden and Chelsea. In dealing with the signalling and safety devices and control of traffic, the book describes what are probably the most interesting phases of underground railway work. The amazing degree of efficiency is evident in the fact that in carrying some 25 millions of passengers per annum, the average rate of accident is 0·3 per million, and there has not as yet been one fatality owing to train operation. For the effective running of such an efficient service, the training of staff is a matter of great importance, and this subject is dealt with in some detail. Engineers will be somewhat disappointed that the rolling stock is rather briefly dealt with, the whole subject being dismissed in one chapter, although the author has used the limited space to give the most interesting particulars. The book concludes with chapters on the Post Office Railway, Omnibuses and Tramways. It is copiously and well illustrated, and is written in simple, non-technical language for the layman, but all engineers will find it of the greatest interest, for, although underground railways are among the finest engineering achievements of the past century, little literature has been published about them.

BOOKS RECEIVED.

Kestrel Aero-engines. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 5s. net.

Oil and Petroleum Year Book, 1932. By W. E. Skinner. London: Walter E. Skinner, 15, Dowgate-hill, E.C. 4. Price 7s. 6d. net.

The Causes of Accidents. By Eric Farmer, M.A. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 3s. 6d. net.

Pulverised Fuel Firing. By S. H. North, M. Inst. F. London: Sir Isaac Pitman and Sons, Ltd, Parker-street, Kingsway, W.C. 2. Price 7s. 6d. net.

Experimental Engineering Science. By N. Harwood, B.Sc. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 7s. 6d. net.

Trägheits-und Widerstandsmomente von Blechträgern. By Dipl.-Ing. P. Krugmann. Berlin: Verlag von Julius Springer, Linkstrasse 23–24, W. 9. Price 27 marks.

Motorships of the World. Edited by A. C. Hardy, B.Sc., &c. London: Sampson Low, Marston and Co., Ltd., 100, Southwark-street, S.E. 1. Price 12s. 6d. net.

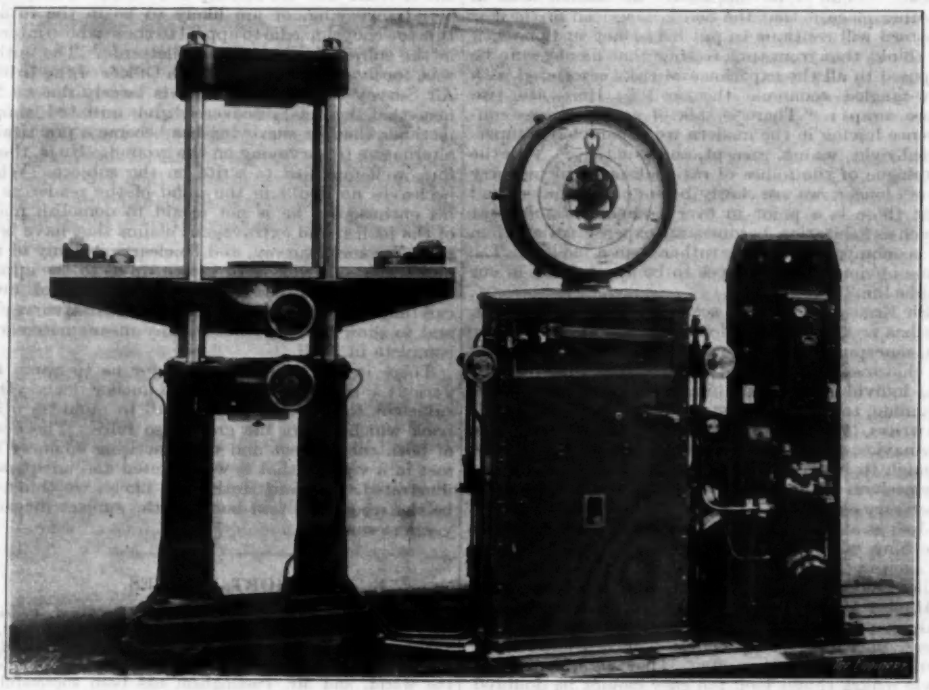
Electrons and Waves: An Introduction to Atomic Physics. By H. S. Allen, F.R.S. London, Macmillan and Co., Ltd., St. Martin's-street, W.C. Price 8s. 6d. net.

The Manufacturing Industries of the British Empire Overseas: Part VI., Africa, West, East and Central. London: Erlangers Ltd., 4, Moorgate, E.C. 2. Price 7s. 6d. net.

Chemical Plumbing, Lead Burning and Oxy-acetylene Welding for Plumbers and Heating Engineers. By E. B. Partington, R.P., A.R.S.I. London: British Oxygen Company, Ltd., Victoria Station House, S.W. 1. Price 5s. net.

SELF-INDICATING UNIVERSAL TESTING MACHINE

W. AND T. AVERY, LTD., BIRMINGHAM, ENGINEERS



Self-Indicating Universal Testing Machine.

THE self-indicating universal testing machine, which we illustrate herewith, has been designed by W. and T. Avery, Ltd., Birmingham, to meet modern commercial requirements, and is made in capacities from 10 tons up to 100 tons. Notable features of this new machine are the clear indication of the load on a graduated dial and the fact that by means of it one operator can carry out any of the usual tests—tension, compression, transverse, bending, and shearing. Both weighing and straining are

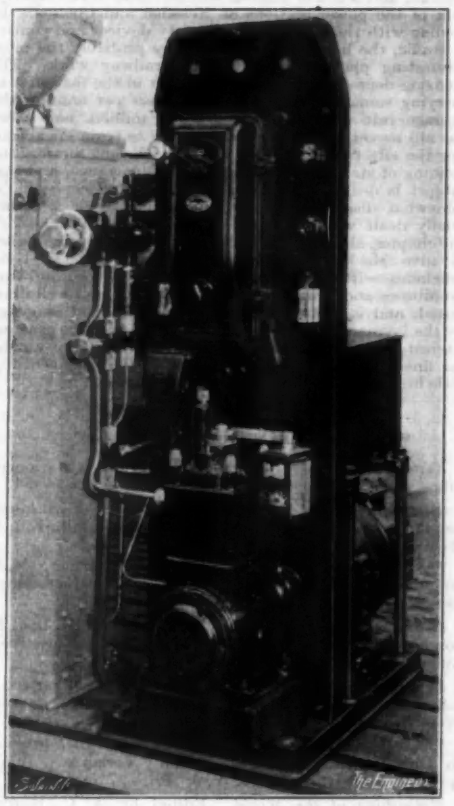


FIG. 1—CONTROL PANEL

effected through the medium of hydraulic pressure, which is applied simultaneously to the main cylinders of the straining gear and to a small cylinder housed in the load indicator cabinet. The ram of the small cylinder is in direct connection with the weighing mechanism, and is proportionally reduced in area relatively to that of the main cylinders. The machine illustrated is of 60,000 lb. capacity.

THE PUMPING UNIT.

The pressure necessary for applying the load is provided by a motor-driven reciprocating ram type oil pump which has three rams and positive automatic seated valves. The main shaft is carried in a cast iron housing which is bored to receive the main bearings and end cover and machined to carry the pump body. The pump housing is oil-tight and an oil-retaining seal is provided at the point at which the main shaft emerges from it. The pump body consists of a forged steel block and into it are pressed phosphor-bronze liners in which the three rams work. These rams are of steel, case-hardened, and ground and lapped to a fine sliding fit in the three phosphor-bronze liners. No packings are used. The valves also are of steel. A cast iron suction bonnet is bolted to the top of the pump body; the whole arrangement is inverted—that is, the rams are arranged above the shaft and the valves above the rams. The pump is direct driven by a constant-speed motor running at 750 r.p.m. and has a delivery sufficient to give a maximum speed of 4in. per minute to the main rams of the testing machine.

CONTROLS.

The supply from the pump is controlled by valves arranged at the sides of the load indicator cabinet, as shown in the photograph reproduced at the head of this page. The delivery from the pump is conveyed to a connection on the duplex control valve at the right-hand side of the cabinet, and the supply to the cylinders of the testing machine is regulated by the hand wheels, the excess delivery from the pump being by-passed back to the pump suction tank.

To eliminate pulsations from the pressure supply to the testing machine cylinders a momentum valve is incorporated in the pipe line, and further to obviate pulsations in the pressure transmission to the small proportional cylinder a separate pipe is taken from the main cylinders to the proportional cylinder. Any slight pulsation which may remain in the pressure supply is thus completely damped out when taken from the large cylinder area. The valve at the left-hand side of the indicator cabinet controls the exhaust from the testing machine cylinders. The maximum speed of the main rams on the return stroke is 3ft. per minute. This valve also serves to control the pressure of the oil transmitted from the main cylinders to the small proportional cylinder in connection with the lever system of the load indicator. The load on the specimen is maintained or relieved according to the operation of the hand wheels of this valve.

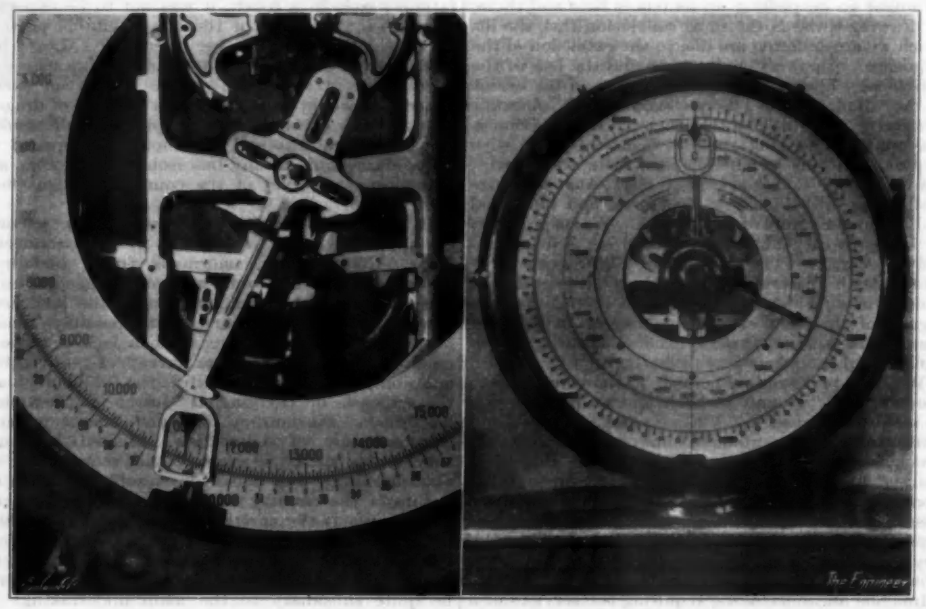
A feature of the machine is that it can be arranged for automatic control, by means of which a test load may be automatically maintained—within small limits—upon a specimen. When this device is in use two pump suction valves are depressed by means of a cam plate, making them inoperative, and the one valve remaining in service is brought under the control of a solenoid, to be seen at the side of the pump in Fig. 1. If the solenoid is energised the remaining suction valve is depressed and the pump delivery suspended, and *vice versâ*. Limit contacts may be arranged in any position on bus-bars at the rear dial of the machine, as illustrated in Fig. 2. The weighing pointer operates between these contacts to maintain the load within the limits thus fixed. When the weighing pointer, which is provided with a suitable contact, reaches the high limit an electrical circuit is completed to operate a relay switch, by means of which the solenoid controlling the pump suction valve is energised, the suction valve depressed, and the pump delivery suspended until the weighing pointer falls sufficiently to make contact at the low limit when another circuit is completed to reverse the relay switch. This action de-energises the solenoid controlling the pump suction valve, and delivery is resumed until the weighing pointer again reaches the high limit contact.

As a precaution against damage to the dial mechanism through faulty manipulation, the weighing pointer is made flexible and is therefore able to pass the limit contacts in either direction in case of emergency. Fig. 2 illustrates the pointer flexing to pass the contacts. To facilitate the quick adjustment of the limit contacts the back door of the housing is hinged in order that it may be opened wide to give free access to any position on the dial. An electrical interlock is incorporated with the door so that immediately it is opened the electrical circuit is broken, isolating the whole dial mechanism. The circuit is completed again when the door is closed. Signal lamps at the top of the control panel indicate the operation of the relay switch.

Provision is also made for carrying out automatic control tests by means of a spring-loaded valve. This valve, which is situated on the indicator cabinet directly beneath the main control valve, is normally kept closed, but may be set to relieve at a pressure corresponding with a desired load to within a small limit of fluctuation.

THE CONTROL PANEL.

The control panel—Fig. 1—is arranged to the right of the fine regulation valve, so that all the controls are localised. Upon the panel are arranged the main electrical isolation switch, the motor controls, and a two-way switch which serves for both the maximum load pointer and the automatic control circuits. The signal lamps for these circuits are also arranged on the panel, whilst immediately beneath the two outer lamps, which are arranged behind small coloured windows, press button controls are situated, which are provided to reverse the action of the automatic control circuit when required. A plug connection for a flexible lead for use with an extensometer, &c., is provided upon the panel.



FIGS. 2 AND 3—REAR AND FRONT FACES OF INDICATOR DIAL

THE STRAINING GEAR.

The cylinders are single acting and are arranged side by side upon a base-plate. Both the cylinders and the rams are machined and ground to fine limits, and operate without packing, with no appreciable friction or leakage. To prevent grit and dirt getting to the rams special housings for wipers are fitted at the top of each cylinder.

The bottom grip holder is secured between the two cylinders and ties them together at the top. The top grip holder is embodied in the beam casting and is secured to the top of each ram. The centre portion of the beam is used for compression tests, for which a suitable platen is provided, and directly above, supported upon rods secured in

lugs at the side of each cylinder is arranged a crosshead which provides the face to which is secured the top compression platen and also the presser foot used for transverse tests. The end supports for the transverse and bend tests are carried upon the beam casting, the actual position being adjustable. The two front rods supporting the top crosshead are graduated to provide a means for measuring the deformation of tension, compression, or transverse specimens. The machine illustrated is arranged to accommodate tensile specimens up to 1in. diameter and flat specimens up to 3in. wide. The minimum distance between the grip holders is 3¼in. and the maximum distance 24in., the stroke of the rams being 20½in. Recoil plates are provided immediately behind the wedges in both the top and bottom grip holders.

The grip holders are steel castings. A hand wheel

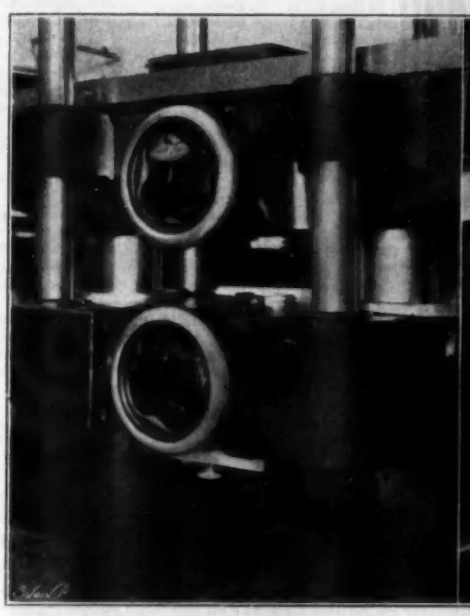


FIG. 4—WEDGE GRIPS

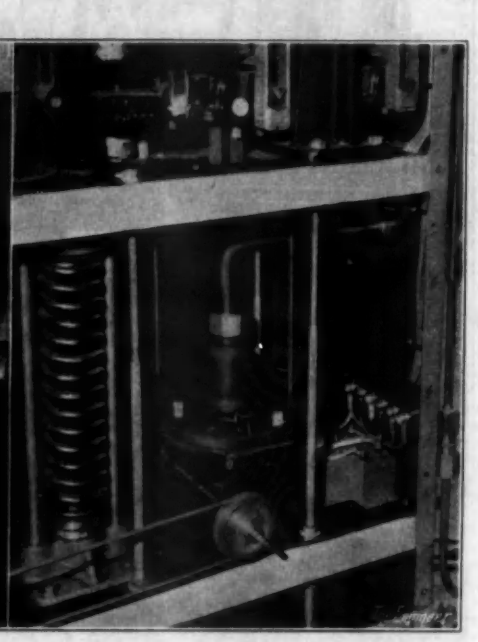


FIG. 5—PROPORTIONAL CYLINDER

within easy reach of the operator—see Fig. 4—rotates a shaft having at its end a pinion which can be put into gear with a rack arranged at the back of the wedge grips. By this means the grips may be raised or lowered whilst they are automatically opened or closed as they slide up or down guide recesses in the holders.

For compression tests which are carried out between the beam casting and the top crosshead hardened steel platens 8in. square are provided. They have inscribed upon them circles 2in., 4in., and 6in. diameter to assist in the location of specimens, the length of which may be varied up to 21in. For transverse tests a presser foot is substituted for the top compression platen. The maximum depth of transverse specimen which the machine will accommodate is 12in. and the maximum span 51in. The supports are provided with rollers to receive specimens up to 8in. in width and are adjustable from 12in. span for transverse specimens. For short bend tests the supports may be adjusted to a minimum span of 6in. To facilitate adjustment of the specimen supports to the required span a graduated silveroid scale is provided on the beam casting.

THE LOAD INDICATOR UNIT.

The load indicator comprises a cam-resistant type of weighing mechanism, a small cylinder, and the necessary reduction levers. The ram of the small cylinder—shown in Fig. 5—is proportionally reduced in area to that of the main rams in the straining gear. The load applied at the main rams is therefore reduced at the proportional ram and is transferred through the reduction levers to the dial mechanism and indicated upon the chart. In order to eliminate friction the ram of the proportional cylinder is arranged in a phosphor-bronze liner, which is steadily rotated during a test. Provision is made to ensure the absence of shock to the indicator mechanism after a test by means of a dashpot and capilliary valve.

The chart is very easy to read, as will be seen in Fig. 3. The reading line is 18in. in diameter. The chart illustrated is for a machine of 60,000 lb. capacity and is graduated by 100 lb. divisions. The main chart is of the shadowless type, being relieved to receive the indicating pointer, thereby preventing parallax difficulties. In addition a chart is provided at the rear of the housing so that load indications may be observed from any position at the front or back of the machine. If required for testing specimens for which a lower load is suitable, a second set of graduations may be used. When it is desired to use this range it is only necessary to change the ratio of the leverage in the cabinet. This change is easily accomplished by turning a small handle at the front of the load indicator cabinet through 180 deg. For the machine illustrated this second set of graduations extends to 24,000 lb. by 50 lb. divisions.

A device is fitted which is designed to leave indicated upon the dial the maximum load reached during a test. A second pointer is provided, which is carried in frictionless bearings in a small housing secured to the glass of the dial. This pointer, which may be seen in Fig. 3, is carried round by the main load indicating pointer and the contact thus made is used to pass an electric current to a solenoid in the small housing which, when energised, relieves a friction pad situated adjacent to the loose pointer, leaving it free to rotate. Immediately the main load indicating pointer moves in a backward direction the electric circuit made by the pointer is broken and the solenoid is de-energised to allow the friction pad to retain the loose pointer in the maximum position reached during the test. It is relieved by twisting by hand the knob on its spindle. To indicate that the electrical circuit for the maximum pointer is functioning a signal lamp is provided, which illuminates the central window arranged at the top of the control panel

The dial housing is fitted with air-tight rubber gaskets and an oil seal, making it dust and moisture proof. The cabinet also is of the closed type and protects the inner mechanism from dust, &c. Provision is made to prevent the load being transmitted to the dial mechanism when desired, by a simple locking device, a turn of a locking handle only being necessary. The application of the load to a specimen may be as rapid as up to the full capacity of the machine in half a minute, or it may be controlled to extremely fine limits. For instance, the control valve may be set to maintain a load whilst an extensometer reading, &c., is taken, or to obtain a very steady return of the load-indicating pointer even as it recedes after the yield point of a tension specimen has been passed.

The first testing machine of this type has been installed at the Central Technical College, Birmingham. In its design and construction Messrs. Avery received helpful co-operation from Mr. W. R. Barclay, chairman of the Advisory Committee of the College, and from Dr. Stirling Anderson, the Principal of the College.

South African Engineering Notes.

(*By our South African Correspondent.*)

Remarkable Gold Ore Find.

AT the Witwatersrand Deep Gold Mine, Germiston, near Johannesburg, a remarkable find of ore has been made. A piece of ore weighing 517 oz., of which about 75 per cent. is expected to be pure gold, has been taken out of the upper levels of this mine in No. 17 district. This is believed to be the largest specimen of gold ore ever found on the Rand. About two years ago at the City Deep Mine a specimen of less than half the size of the present find was discovered, and was then regarded as something unique so far as the Rand is concerned. The find was made right up against a dyke. Another piece of ore, really a split-off from the large piece, weighed just over 100 oz., but this was not nearly so rich. The current value of the 517 oz. specimen, accepting it at 75 per cent. gold, would be about £1600. The Mining Company is placing the nugget on view for a few days before it is finally crushed and refined. It is recognised by the company that the find will be of the greatest interest to geologists; hence the putting of the specimen on view. There was no indication at the site of the discovery of the specimen that the richness of this piece is other than peculiarly local to that particular spot, and it is not expected to find the average assay value of the reef in that area any greater than in the other sections of the mine. The Witwatersrand Mine made a loss of £9886 in its last working year, so the find is a particularly welcome one for the company.

Congella Power Station.

The Congella (Durban) power station is to be extended by the addition of one 12,000 kW three-phase turbo-alternator, and two pulverised coal fired boilers, with a normal rating of 120,000 lb. of steam per hour, the biggest in South Africa. The present plant consists of two 12,000 kW sets and two of 6000 kW each, and the boiler plant consists of six boilers, each of a normal capacity of 60,000 lb. of steam per hour, and fired by pulverised fuel. The total capacity of the station, which is designed for an eventual 72,000 kW, is now 48,000 kW. It is understood that from the beginning of May the Durban Corporation, which is practically the only customer that the Electricity Supply Commission has for its Natal Congella station, will require the following supplies:—A maximum demand of 30,000 kW; a maximum supply of 115,000,000 units per annum. The tariff for supplies has been revised and is now (*a*) a charge of £4 4s., reduced from £5 8s. for each kW of the maximum demand supplied in each year, plus (*b*) a charge of 0·175d. (reduced from 0·2d.) for each unit supplied. The new 12,000 kW generating set is a three-phase turbo-alternator, complete with exciter, condensers, circulating water pump, auxiliary plant, valves, and piping, for use in supplying electrical energy to the system of the Commission. This plant was supplied by C. A. Parsons and Co., Ltd., Heaton Works, Newcastle-on-Tyne, and is a duplicate of the two plants installed under the 1926 initial programme. The turbo-alternator, 6600 volts between phases, is designed to run at a normal speed of 3000 r.p.m., and to operate with steam at a pressure of 250 lb. per square inch (gauge) superheated to a total temperature of 700 deg. Fah., exhausting to the condenser at a pressure of 1·5in. of mercury. It is capable of giving, for two minutes, an output of 20,000 kW. The turbine is of the reaction type, consisting of a single cylinder with duplex exhaust, and is arranged for the extraction of steam at two points. The feed water is heated up to a final temperature of 190 deg. Fah., when the plant is running at an economical output under normal conditions.

Loan Estimates.

It appears from the Loan Estimates tabled by the Union Minister of Finance, that he will have to find £9,000,000 to finance the capital expenditure proposed by the Government this year. There is a decrease on the previous year's estimates of £1,077,000. In connection with the iron and steel industry which is being built up at Pretoria, £1,750,000 is to be provided for the taking up of "B" shares issued by the Iron and Steel Industrial Corporation. One million is being provided for railways and harbours, which is a decrease of £900,000 compared with last year; telegraphs and telephones, £400,000, a decrease of £169,000; irrigation, £555,000, a decrease of £271,000; local works and loans, £1,408,000, a decrease of £605,000; public works, £486,000, a decrease of £160,000.

Hydro-electric Schemes.

The fact that the Municipality of Livingstone (the present capital of Northern Rhodesia) has favourably considered a scheme by which light and power can be provided for the town by harnessing the Victoria Falls has resulted in a good deal of attention being directed towards these falls and their possibilities of supplying light and power to various parts of the Union. It is assumed by some that because the falls are twice as broad and more than twice as high as the Niagara Falls, which have been used effectively for this purpose, they must, therefore, be a much better source of power than the American Falls. Actually, however, the Victoria Falls are much inferior to the Niagara Falls as a power source, for, although much higher and broader, the power generated would have to be sent hundreds of miles to the Rand before it could be consumed on any large scale, while the Niagara Falls are in the midst of an area that could be and has been developed industrially. The transport element would raise the cost of Victoria Falls electricity above that of the coal-generated supply at present serving the needs of the Rand. In most of South Africa's electrical schemes distribution has proved the stumbling block. Once the necessary machinery has been erected and the usual preliminary work completed, it may be said that at its source power is free. But to distribute this cheap power is a more expensive matter. Many suggestions have been made of the way in which the current generated by the Victoria Falls, the Orange River Falls, and such energy producers in South Africa, should be distributed; but the only practical method is by means of heavy high-tension cables. The opinions of experts differ about the amount of energy running to waste at the Victoria Falls alone, but the notion generally accepted here is that sufficient current to drive all industrial plants, the railways, and all domestic supply centres in South Africa and Rhodesia can be generated there, and if the coal supplies were not so favourably situated and so large, this work would undoubtedly have been carried out long ago.

Those who are desirous of making the greatest use of South Africa's rivers are proposing the erection of hydro-electric plants at special points, whence water can be pumped to the fertile levels, but such schemes are for the future. For the present the most to be expected is the supplying of Livingstone with its light and power. The growth of towns in Southern Rhodesia, Salisbury, and some others may create a demand which might render a fairly large power station at the falls a paying proposition.

More Sub-stations for Cape Town.

The change over of the lighting in the central area of the city of Cape Town from direct to alternating current, which has been going on steadily for some time, has been responsible for putting into commission during the last 2½ years at least five new distributing sub-stations around the centre of the city. The smallest of these is equipped with two 300-kVA, 11,000/400/230-volt transformers and the largest with two 1000-kVA, 11,000/400/230-volt transformers. Just recently also a building for a new sub-station has been completed at the lower end of Bree-street. This sub-station will be equipped with two 1000-kVA, 11,000/400/230-volt transformers, together with low-tension and high-tension switchgear, the erection of which has already been completed, so that this month—May—another sub-station should be commissioned for supplying the increasing alternating-current load.

Huge Rock Fall in Gold Mine.

Falls of rock in the gold mines of the Witwatersrand goldfield are becoming more frequent and more severe as the workings become deeper. The latest fall took place on the Geldenhuis Deep Mine on April 18th last. This resulted in eighty Europeans and 900 natives being thrown out of work, and the stoppage will probably last to the end of the month. Thousands of tons of rock have fallen and have blocked up the biggest producing shaft on the Geldenhuis Deep as the result of a big pressure burst. The shaft affected is No. 3, or the Western Shaft of the Jumpers Deep section of the mine, and as the output of this shaft is between 1300 and 1400 tons a day

the tonnage and profit of the mine for the month will be seriously affected. There were no casualties, although men were working on the lower level of the shaft at the time of the accident.

Large Generator for Cape Town.

The Salt River (Cape Town) power station of the Electricity Supply Commission has given an order to the same makers for a 20,000 kW turbo-alternator set with a 33,000-volt alternator built on the same principle as machines of this kind working at Brimsdown. The Cape Town turbine will be a single-cylinder machine with duplex exhausts and designed for a steam pressure of 400 lb. per square inch at the stop valve, a temperature of 750 deg. Fah., 28·8 vacuum, and a speed of 3000 r.p.m.

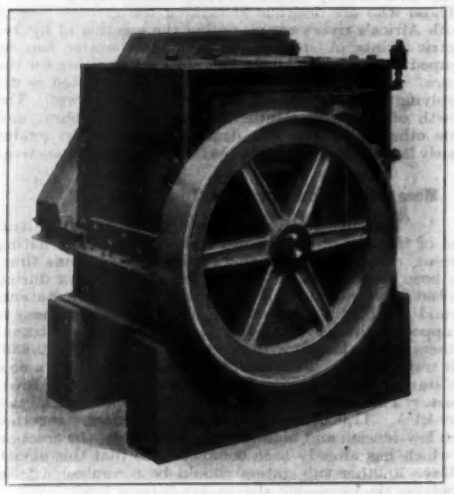
New Gold Mines and Extensions.

Quite recently it was announced that it was not altogether unlikely that one of the next new mines to be opened upon the Witwatersrand would be in the Roodepoort district. For the past year or two most of the projected expansions of Rand mining operations have been centred in the Far East Rand area and in the extension of the Far East Rand proper toward the Nigel area. Now, however, whilst the Far East Rand continues to be the most productive and profitable section of the Witwatersrand goldfield, there have been developments on the West Rand, where improvement has been shown in the affairs of the four big mines situated there—Randfontein, West Rand Consolidated, Luipaardsvlei, and Durban Roodepoort Deep. Then, again, a new company has been formed and will erect plant in order to exploit the rich Black Reef deposits on the farm Waterval 74, near Krugersdorp. In this district there are other propositions which deserve and are now receiving investigation. Perhaps the most important developments are those dealing with the acquisition, sometimes by purchase, sometimes by pegging, and sometimes on lease from Government, of considerable areas of ground containing, it is believed, payable ore in great quantities. These areas have all been acquired by companies which have already mines of considerable importance in full operation, and situated immediately adjacent to the areas they acquire, so that the payability of the area can be tested by drives from the present working mines into the newly acquired areas, without the necessity for sinking costly shafts until it is ascertained whether doing so is justified. The new extension of the Sub-Nigel will add well over 20 years to the life of the mine if anticipations are realised. A substantial extension of life has also been made in the case of the Simmer and Jack, which first dropped stamps in September, 1888.

Several mines have considerably improved their prospects recently. The Randfontein Estates development of the principal section of the mine is in a very interesting stage. In the last annual report it was stated that the reefs, of which there are two, separated by 180ft., had a steep dip, averaging 58 deg. east from the surface to a depth of 4000ft., but that accumulated data showed a progressive flattening below that depth; further, that in all probability, all the Main Reef Series would lie at a workable depth. The year's development work fully bore out such anticipations, and there is now no reasonable doubt that the flattening is, and will continue to be, progressive; that the reefs some two to three thousand feet beyond the present lowest exposures will be flat, and further east will assume a reverse dip. In other words, the reefs will lie in the form of a large synclinal fold. Permanent works have been designed to take advantage of the change.

A Three-Stage Coal Breaker.

In the accompanying illustration there is to be seen a new coal breaker recently introduced by Hadfields, Ltd., of Sheffield. It is capable of taking "run-of-mine" size coal and reducing it in one operation down to ¾in. cubes and under. Actually the machine performs the operation, for which usually at least two breakers are required, in three stages. Within the rectangular framework of the body there are two crushing rolls mounted parallel to one another on one of the diagonals of the rectangular framework. The fly-wheel to be seen in the illustration is connected to the lower and the external bearing of the upper roll can also be seen. The two rolls rotate in opposite directions. The upper one is furnished with circular claw cutters threaded on a square shaft, whilst the lower comprises a roll shell with small teeth fitted on a cast iron centre. Each roll is equipped with a breaker plate. That for the upper is fixed and is mounted immediately above the lower roll. The other plate is pivoted immediately beneath the upper roll, its bearing being visible in the illustration between the spokes of the fly-wheel. Strong compression springs and long screwed bolts and nuts to regulate the size of the product hold it in position close against the underside of the lower roll. The rolls are gear driven, the lower roll rotating at a much higher speed than the other.

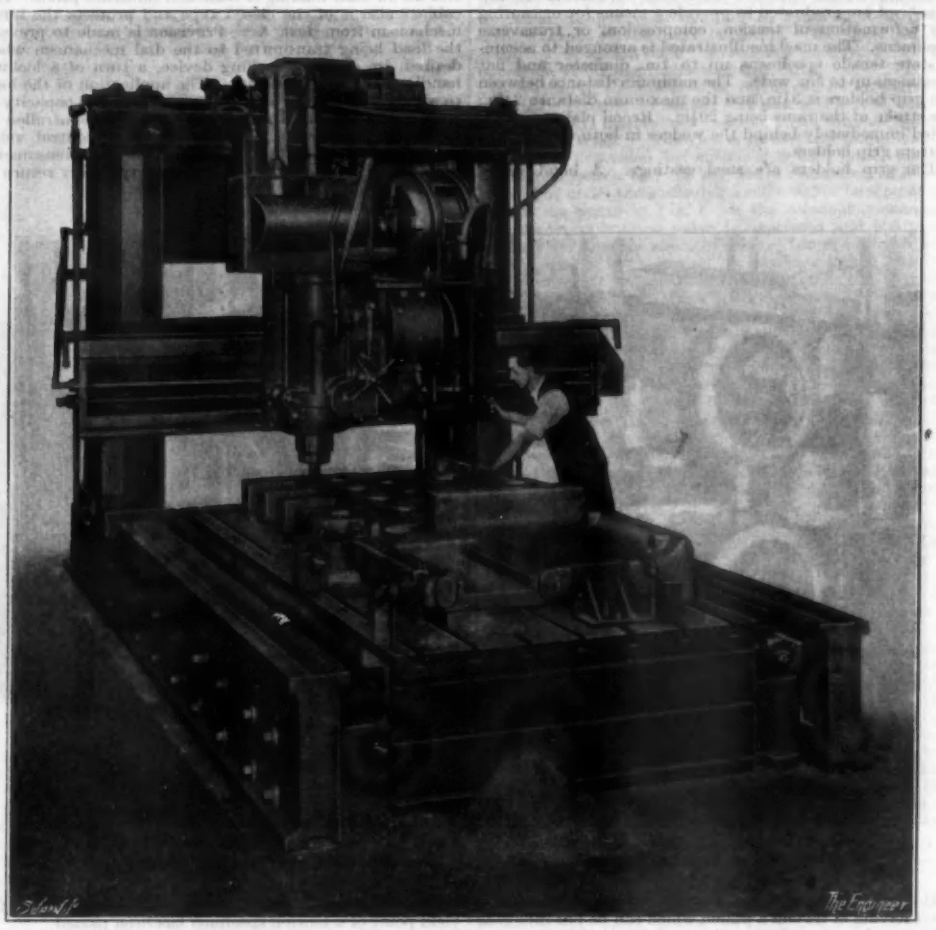


COAL BREAKER

In action the coal to be broken is first positively gripped by the claws of the top roll, forced downwards, and broken against the upper breaker plate. Thence it passes between the two rolls and is further broken to a size sufficiently small to be caught by the lower roll, and is finally crushed to size against the adjustable breaker plate.

VERTICAL SPINDLE MILLING MACHINE

SLEEPER AND HARTLEY, INC., WORCESTER, MASSACHUSETTS, ENGINEERS



An American Milling Machine.

THE vertical spindle milling machine illustrated on this page is of unusual design. It is made by Sleeper and Hartley, Inc., of Worcester, Massachusetts, and in outward appearance rather resembles a planer type miller, but in actual fact the table is stationery, while the columns travel along ways on the bed. This arrangement, of course, effects a considerable saving of floor space.

The base is cast in one piece, braced to give rigidity, and the columns are of strong box section. The cross rail is of deep section to ensure stiffness, and extends some distance beyond the columns to give the head as great a side travel as possible. The machine is equipped with two motors, which provide ample power for operating the feeds and power traverses. The travelling head can be fed in either direction at a suitable number of speeds and the traverse operates in either direction with a positive interlock with the vertical feed. It is possible to cross traverse a cross feed whilst the head is also travelling longitudinally along the table. The cross rail is moved by power and once in position can be clamped down firmly, the controls for this operation being duplicated on each side of the machine. The spindle is driven by a four-speed 10 H.P. motor mounted on the same frame as the spindle, which it drives through a worm gear. Eight spindle speeds are available. All the other motions are operated by a 7 H.P. motor mounted on the cross tie at the top of the columns. All the electrical controls are of the push-button type. Practically all the controls are duplicated, so that the operator has them close at hand on either side of the machine.

The machine illustrated takes up a floor space of 20ft. by 13ft., has a table area of 12ft. by 5ft. 2in., and a capacity of 14ft. by 8ft. It weighs 45,000 lb. Spindle speeds available range from 16 to 307 r.p.m., and feeds from 0·001in. to 0·27in. per revolution. The cross and longitudinal feeds range from 0·002in. to 0·406in. per revolution of the spindle. We are informed that the machine is capable of finishing five surfaces of work without changing the position of the piece on the table. The makers claim that in comparison with the planer type miller, the new machine gives greater accuracy, owing to the constant pressure of the head on the cutter and the fact that varying sizes of work cause no deflection of the table.

Exceptional Feat of Transport.

AN interesting feat of transport is in course of accomplishment. The firm of C. A. Parsons and Co., Ltd., of Newcastle-on-Tyne, has two large machines for the generation of electrical current on order from the Copenhagen lighting department for the H. C. Orsted power station. The first of these two machines is being forwarded to Copenhagen, *viâ* L.N.E.R. to Harwich, the Great Eastern train ferry, through Belgium, Germany, and Jutland, direct to destination without transhipment.

The first train, consisting of twenty-three wagons, left Heaton Works, Newcastle-on-Tyne, at midnight on Saturday, June 4th. All the wagons carrying heavy and exceptional pieces of machinery were supplied by the L.N.E.R. for conveying these loads to Copenhagen. The lighter packages were loaded in German and Belgian wagons to obviate the necessity for returning all the wagons from the Continent to England after the transport has been completed. The route is interesting in many respects. Not only have the wagons to be conveyed between Harwich and Zeebrugge on a train ferry, but after being hauled through Belgium and Germany and through the Danish province of Jutland to Fredericia, they have to be placed upon another train ferry for conveyance to Strib. At this point the wagons will be discharged from this ferry and hauled over the island of Funen by rail to Nyborg, where again they will be loaded on the third train ferry for shipment to Korsor, from which point they will be hauled by rail to their ultimate destination at Copenhagen. The distance is 1200 miles.

Included in the consignment are many heavy packages. Amongst them is a stator weighing approximately 60 tons, an electrical rotor weighing 38 tons, parts of the turbine engine weighing up to 30 tons, and so forth. Each of these loads may be considered to be exceptional, not only in weight but in dimensions. Each necessitates the use of a special vehicle, and all such vehicles are being supplied by the London and North-Eastern Railway. The stator is the heaviest part of the alternating-current electrical generator. The dimensions are such as to necessitate the train being run on a Sunday between Newcastle and Harwich, and also in Germany between Hamm and Luneburg on the following Sunday. On arrival at Fredericia the stator as loaded on the special truck may have to be raised about 6in. by Messrs. C. A. Parsons and Co.'s representatives to enable it to clear fittings on the Danish ferry boat. It will again be lowered for hauling over the railway to Copenhagen after discharge from the ferry boats. Except for this operation, the loads will remain intact in the wagons from the time they are loaded at C. A. Parsons and Co., Heaton Works, Newcastle-on-Tyne, until they are discharged by them in the power station belonging to the municipality of Copenhagen.

The machinery is comprised of two 36,000-kW turbo-alternators. The turbines are of the two-cylinder tandem pure reaction type, coupled to a 36,000-kW alternator running at 1500 r.p.m. They are designed to operate with steam at 323 lb. gauge pressure (22 atmos. gauge), superheated to a total temperature of 743 deg. Fah. (393 deg. Cent.), and exhausting at a vacuum of 29·0in. Hg. when running at the economical load of 25,000 kW. Except for the exhaust portion where the temperature and pressure of the steam are both very low, the whole of the high-pressure cylinder and the steam chest is of cast steel.

The high-pressure spindle, in common with the low-pressure spindle and alternator rotor, is bored through from end to end, and every portion of the interior surface is carefully examined by means of a "borescope," to make sure that no flaws exist in the metal. As a further precaution, the spindles were run to 33½ per cent. over-speed in a specially constructed overspeed testing chamber. The integral blades are not machined from bars in the usual way, but are manufactured in their finished form by a special rolling process, the effect of which is to increase their strength by ensuring that the grain of the metal is continuous from end to end. So successful has been the design that not a single blade failure has occurred since its adoption. Turning gear has been fitted to the machines to enable the shafts to be revolved, either when starting up or after the machine has been shut down. Even cooling of the spindles with consequent absence of distortion can be ensured in this way.

The alternator is designed for a continuous output of 40,000 kVA or 36,000 kW at 0·9 power factor. It runs at 1500 revolutions per minute, and supplies current at 6000/6500 volts and 50 cycles. The stator casing is of mild steel, electrically welded, thus ensuring a sound and rigid construction with the minimum of weight.

The rotor is machined from the solid forging of high-grade mild steel. A hole is trepanned through the centre from end to end to enable a thorough examination of the metal to be made so as to be sure that no flaws or other defects exist.

Small Portable Welding Set.

THE increasing use of small portable welding sets is becoming more and more evident, and we understand that the Parsons Oil Engine Company, Ltd., has orders in hand from Metropolitan-Vickers for about forty of its welding equipments driven by direct-coupled Parsons D 4 S 10/20 H.P. petrol engines. Engine and dynamo together with radiator are placed on a low four-wheeled truck with draw-bar, forming a handy and com-

10-20 H.P. PORTABLE WELDING SET

pletely independent plant. The electrical portion comprises the well-known Metropolitan-Vickers single-operator arc welding generator, with exciter mounted in the end bracket. These generators are suitable for either bare wire or covered electrodes, and are of the reverse compound wound type, so that as the current increases in the arc, the generator voltage becomes automatically reduced, with the result that it is an exceptionally easy task for the operator to strike and maintain an arc that gives constant heating effect with the penetration and fusion necessary for good welding. The Parsons D 4 S engine drives the dynamo by the makers' standard bolster coupling, and runs in this case at 1450 r.p.m. with an output of somewhat over 16 B.H.P., the cooling fan being mounted at the forward crank shaft end. The governing of these welding plants is of great importance, and the sensitiveness of that fitted to these engines is remarkably good. The whole plant weighs less than 19 cwt., and the overall length is only 7ft. It is illustrated in the accompanying engraving.

THE GENERATION OF ELECTRICITY IN GREAT BRITAIN.

THE analysis and summaries of the returns of fuel consumption and units generated by authorised undertakers and the returns furnished by railway and tramway authorities for the year ending December 31st, 1931, have just been published by the Electricity Commissioners. Returns were received in respect of 538 generating stations, a decrease of twenty-one from the number included in the last return for the year ending December 31st, 1930. The difference was accounted for by the permanent closing of thirty-three stations before January 1st, 1931, by the putting into commission of three new stations and one existing standby station during the year, and by the inclusion in the return of eight other existing stations which had been previously operated on a non-statutory basis, but became part of authorised undertakings during the year. The total number of units generated at the 538 stations was 12,812,700,970, an increase of 3·89 per cent. on the figures for 1930, and the total amount of coal and coke consumed was 9,927,135 tons, or a decrease of 0·69 per cent. Excluding the Guernsey station, the 537 stations which fall within the area groupings generated 12,809,350,246 units, and consumed 9,926,079 tons of coal, coke and fuel oil. As usual, the publication contains a table of group stations with highest thermal efficiency.

The station highest in all groups is the Deptford West station of the London Power Company, which had a thermal efficiency of 24·02 per cent. Deptford West is in group A, which covers stations which generated 200 million units and over. Next to this station in order of thermal efficiency is the Kearsley station of the Lancashire Electric Power Company, with an efficiency of 23·85 per cent. This is in group B, embracing stations which generated at least 100 million units, but less than 200 million. The Kirkstall station of the Leeds Corporation, in group C, taking in stations generating not less than 50 million, but under 100 million units, showed 21·95 per cent.

LARGE DOUBLE-ACTING C.I. ENGINE FOR SHANGHAI.

FOR a number of years the power station in the French Concession, Shanghai, has, by periodic additions to its generating plant, maintained a position as the highest powered oil-engined generating station in the world, until some months ago, when its output was exceeded by the 35,000 B.H.P. station at Vernon (California). Recently, the Shanghai Company has placed an order with Sulzer Bros. for an engine to develop 11,400 B.H.P. normal, 13,100 B.H.P. maximum output. When this engine is installed the Shanghai station will regain its lead with a continuous service rating of 42,600 B.H.P. and a peak load capacity of over 50,000 B.H.P. The new engine will be of the double-acting, two-stroke type, with eight cylinders, 760 mm. bore by 1200 mm. stroke, and will give its rated output at 136 r.p.m. The design generally will be similar to the 10,800 B.H.P. Sulzer engine which has been on peak load service for some months at Fribourg, in Switzerland, and during a considerable part of the time has carried its rated load for six to twelve hours a day owing to the water shortage at the hydro-electric plant. The present plant in Shanghai consists of two 1500 B.H.P. and one 3600 B.H.P. engines installed before 1924, one 3600 B.H.P. set installed in 1925, one 5250 B.H.P. set installed in 1928, one similar set put into service in 1929, and two further sets of the same size installed in 1931. All eight engines are of the Sulzer single-acting, two-stroke type, and are direct-coupled to fly-wheel type alternators. The company has also a Diesel engine pumping station at Tonkadou, Shanghai, with three 750 B.H.P. four-stroke Sulzer engines.

Sulzer Bros. have recently obtained an order for a 1000 B.H.P. engine for the Constanza Harbour Authorities. An engine of the same type has been ordered by the Alto Alentejo Hydro-electric Company (Portugal). This engine will drive a 6000-volt alternator working in conjunction with hydro-electric plant.

IN the House of Lords on June 3rd, Lord Monkswell expressed his scepticism as to the advantages of the electrification of surface railways, and suggested that the reason why the railways did not publish full figures of its cost was that experience had shown that the system was a failure. The Earl of Plymouth, in reply, said that the Government were not in possession of the full details of this expenditure, and it was not considered that any useful purpose would be served by publishing the figures, even if the company were agreeable to that course.

Transmitter and Receiver on an Autogiro.

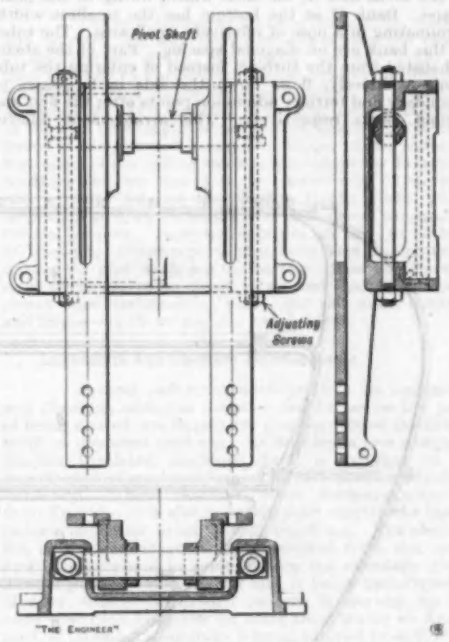
THE accompanying illustration shows a Marconi transmitter and receiver fitted in the Cierva autogiro used by New Scotland Yard for traffic control on Derby Day. The receiver (above) is the Marconi Company's newest

WIRELESS EQUIPMENT IN COCKPIT

design for short wave working in the air, and is known as the type A.D. 23 A. The transmitter (below) is an S.P. 3 A portable telephone transmitting apparatus, embodying an independent valve "drive" circuit. On the right are the winch and fairlead for the trailing aerial.

A Belt-Drive Mounting.

THE accompanying drawing shows a mounting for an electric motor belt drive recently developed by Crofts (Engineers), Ltd., of Bradford. It will be seen that it consists of a base plate proper, which is bolted to the foundations. Upon the plate two cantilever arms can swing on a pivot shaft. The motor is mounted on the pivoting arms, and in consequence its weight maintains the tension

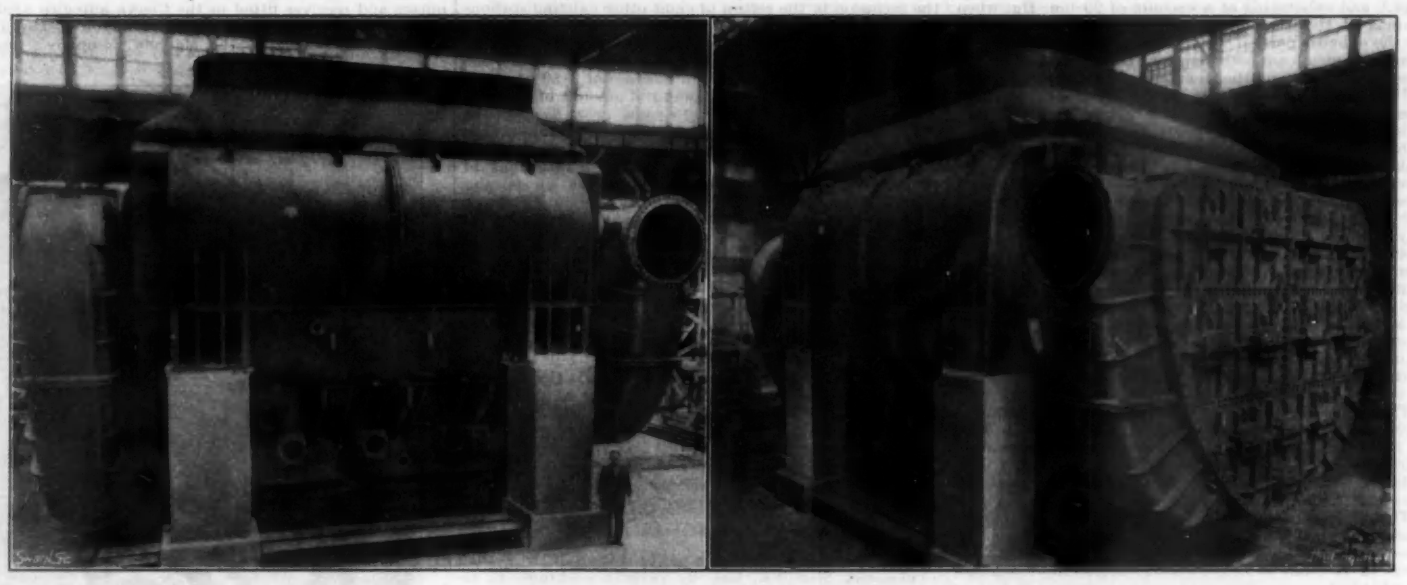


BELT-DRIVE MOUNTING

on the belt. It will be observed that the motor can be bolted on to the arms in four different positions. In this way the tension on the belt can be altered to suit the conditions of working, whilst the position of the pivot shaft can be altered within the base plate by the use of adjusting screws, so that adjustments for belt length may be made. Once set, the mounting automatically adjusts itself to any stretching of the belt. We were able to see in the maker's works some motors mounted in this manner driving compressors, the load upon which was varying rapidly and widely. The device worked perfectly, and the rocking of the motor even under extreme conditions of load variation was slight. Besides that illustrated, the makers also construct a mounting on the same principle for attaching to the side of a machine, such as a lathe.

SURFACE CONDENSER FOR BROOKLYN EDISON COMPANY

THE INGERSOLL-RAND COMPANY, NEW YORK, ENGINEERS



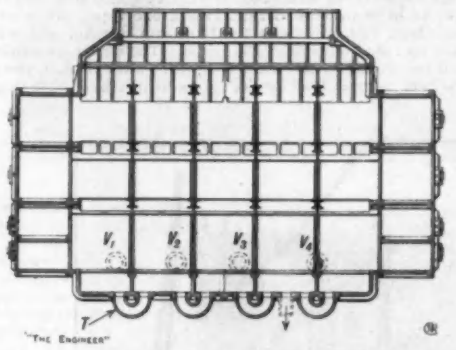
A Large Surface Condenser.

THE accompanying engravings illustrate the Ingersoll-Rand surface condenser, which has been supplied to the Brooklyn Edison Company, Brooklyn, New York, to serve an additional turbo-generator which that company has installed at its station. The condenser is interesting, not only from the point of view of its size, but also as regards its design and construction.

The design is characterised by the heart shape cross section, with subdivision on the steam side into four horizontal banks extending across the condenser and into five compartments along the length of the condenser. On the water side it is characterised by subdivision of the water boxes into four horizontal superimposed compartments.

Considering first the steam and air flow in the cross-sectional view, the design is roughly analogous to the reverse of a steam turbine with two bleed points. Starting at the top, a bank of tubes A extends across the entire width of the condenser with the tubes arranged in rows, as indicated. Large areas are provided for the steam, the tube spacing in this respect being again analogous to the last rows of blades in a turbine. The areas contract as the steam flows through the bank. Banks B and C are similar in design to bank A, with further contraction in the areas and in the shell width, owing to the heart shape. Bank D at the bottom has the smallest width, terminating in a nose of relatively small area. The tubes in this bank are on diagonal spacing. Part of the steam exhausted from the turbine, instead of entering the tube bank A directly, flows down the side in by-passes to secondary and tertiary admission points after the first and second banks respectively. This arrangement relieves congestion in the top of the condenser just as bleeding relieves congestion in the last wheels of a turbine.

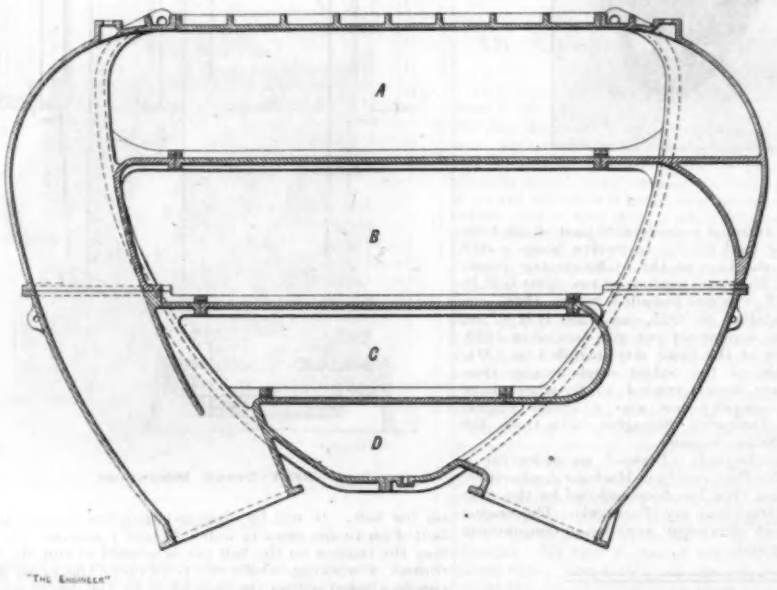
The rectangular hotwell at the bottom of the condenser collects the condensate while the vapour and air turn and flow through multiple nozzles to the external coolers E. These coolers are built integrally and contain 1000 square feet served with circulating water. The vapours make a number of passes over the tube surface, which results in their concentration and devaporisation. Primary ejectors P then extract the devaporised air at high vacuum and discharge to an intermediate vacuum of about 26in. The compressed vapours and air are, in turn, discharged to an inter-condenser and secondary steam jets, which compress to atmosphere in the usual way. The temperature of the condensate corresponds to the average vacuum at the bottom of the condenser, and is colder in winter than in summer. Although the heat loss is slight with a bleed heating cycle, the condensate is, nevertheless, reheated with steam from the exhaust of the turbine. A short section of the by-pass on one side of the condenser is partitioned off as a conduit to supply steam to a small surface heater.



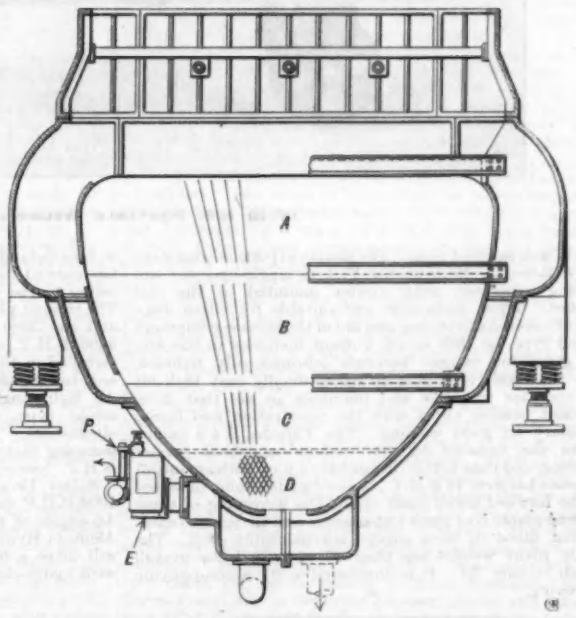
LONGITUDINAL SECTION OF CONDENSER

Longitudinal Distribution.—The condenser is divided longitudinally into five compartments by the four support sheets which are made tight in the shell. The hotwell at the bottom has correspondingly tight partitions. Under the designed maximum conditions with 73 deg. water, 70 per cent. clean tubes, and full power, the average water temperature in the first compartment is about 75 deg. and the average water temperature in the last compartment 88 deg. The condensation in the first compartment is therefore much greater than in the last, amounting to approximately 320,000 lb., as compared to 185,000 lb. The pressure differentials are maintained in the ratio of the squares of the loads by independent vapour outlets V, which connect to independent coolers and primary steam jets. No manipulation of the steam jets is required, as each jet automatically maintains the necessary vacuum at the bottom of each section. The fourth and fifth compartments are combined and served by one cooler and one set of steam jets. In this case the difference in pressure required is obtained by a throttle plate installed in one-half of the vapour outlet nozzle V 4, which serves the two compartments. Condensate flows from one compartment to the other through the sealing traps T, and is finally removed from the hotwell through the condensate outlet nozzle shown. Sufficient hotwell depth is provided to accommodate the levels of water needed to balance the differences in pressure, and also to cause flow through the traps. The water levels stand progressively higher towards the cold end.

Water Distribution.—The design of the water boxes is shown in section. One pump supplies circuits A and C, the other pump circuits B and D. The boxes consist in principle of superimposed sections of shallow height. Each box is therefore in effect a square pipe forming a continuation of the inlet water pipe. Space limitations required the inlet pipes to be built as part of the boxes. The guide vanes and flow paths incorporated in the design were based upon special model tests. The design assures that those banks of tubes which are in service extend across the entire width of the condenser. It is thus possible to operate with only one circulator and without danger of short circuits to the vacuum pump or the necessity of manipulating any valves in the air or vapour lines. This arrangement simplifies operation, and is particularly valuable in cases of emergency. Secondly, it is to be noted



SECTION OF WATER BOX. INLET END



SECTION THROUGH CONDENSING COMPARTMENTS

that water circuit B is 5ft. lower in elevation than the top circuit A. Condensers of large size are necessarily placed at high elevation above tide water and under certain conditions of extreme low tides, it is possible for a syphon to break. In the present case the highest tubes are about 36ft. above extreme low water. With the design shown, the upper circuit could completely lose its water and the condenser still operate with the lower circuit at the 5ft. lower syphon. A third feature of the arrangement is the added flexibility of operation which it gives. The right-hand pump serving banks B and D can be run at reduced speed while the other pump is operated at full speed. Under intermediate load and water temperature conditions, this results in a power saving. The arrangement also tends to decrease tube corrosion.

Experience has indicated that corrosion at tube inlets is associated with air liberation and froth. As the water rises to the high point of the inlet side of a large condenser, a considerable vacuum is exerted on the body of water. This is particularly true when the condenser is operated with pumps at low speed because the friction of the tubes and of the discharge piping is correspondingly low and the syphonic vacuum corresponding to the elevation above discharge level is more nearly reflected in the inlet box. This condition of vacuum causes liberation of air and frothing of the water within the box, and the tube inlets. In the design illustrated, the water is lifted directly to the high points with maintained velocity, thus tending to prevent rapid formation and agglomeration of air bubbles. Furthermore, the air bubbles liberated from other parts of the water, being segregated, cannot concentrate in the higher circuits. As mentioned above, the pump serving the top box can be operated at high speed, while power is being saved on the other at low speed. The increased frictional head through the tubes alone is 6ft., which more than offsets the higher syphon level. All passages in the boxes are arranged as smooth as possible to prevent eddies and sharp turns which are also known to be the cause of froth and air libreation, regardless of syphonic level.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Protection and Reorganisation: Midland Views.

MIDLAND industrialists' views on the Government Committee's decision regarding the iron and steel industry and iron and steelmasters' opinions of the terms on which they are to receive adequate protection against foreign competitors, as announced to them by the Imports Advisory Committee, are of considerable importance in that this area is so largely concerned, not only in the production, but also in the utilisation of iron and steel. While the Committee's recommendation of adequate tariffs for the industry is generally approved, and while it is not taken that the demand for reorganisation casts any reflection on the industry, there is some objection to the dictation by an extra-parliamentary body—under threat—of the reconstruction methods to be adopted. It is recognised that no Government can be expected to subsidise an inefficient industry or to subsidise one industry at the expense of half-a-dozen others, but it is problematic whether the best way to secure efficiency in the iron and steel industry is to dictate to it the manner of its reconstruction, and that under threat of a withdrawal of the protective measures afforded it. Of course, much depends upon how the condition is enforced, and it is hoped that in this connection there will be a cordial collaboration between the Committee and the manufacturers. Lieut.-Colonel J. S. Trinham, President of the Birmingham Iron Exchange and managing director of N. Hingley and Sons, Ltd., Netherton, expressed the following views: "I am convinced that at last the Government have realised that what we have asked for in the matter of protection has been most modest, and that we have not been impatient. I think things are moving in the right direction, but more is needed. The help now suggested is going to be very useful indeed." A representative of a leading steel firm associated with this district said there was a case made out for the reorganisation of the steel industry and a need for co-operation among the members of the trade themselves with a view to securing the advancement of business. The Import Duties Advisory Committee evidently supported that view, and from this aspect the decision was satisfactory and gave hope for future improvement. A Black Country manufacturer said he saw considerable hope in the action and attitude of the Committee. The existing duties had been no protection to the industry. The price of foreign steel had not advanced, so that competition was the same as before the tariffs were imposed. He expressed the opinion that the foreigner was hanging on because he thought that when the temporary duty imposed on the top of the 10 per cent. terminated, it would be removed, and give him the field agian. In these circumstances, it was gratifying to find that the 33⅓ per cent. imposed on certain classes of heavy iron and steel products was likely to be continued for as long a period as might prove necessary. There was a prospect of an extension of the present duties, and were this done, he was satisfied that the foreigner, finding the maintenance of his low prices unprofitable, and seeing that he was unable to force the position and carry out his purpose of making the tariffs appear futile, would retire from the field, and the outlook for the British trade in this respect was hopeful. Conversations on 'Change in Birmingham this week were bright in character, for, it is thought, a turning point in the history of the iron and steel industry has been reached. Undoubtedly the promise of adequate protection should bring new hope and encouragement to an industry which has had much to contend with in recent years, and it is already evident that the leaders of the industry, in this area, at any rate, are ready to rise to the occasion and make the most of what is considered in many circles to be a great opportunity.

Trade Position.

The outlook for the basic industries of the Midlands and Staffordshire has improved considerably since it has become known what the Government intends to do to assist it to secure its future, and spirits which were drooping have revived. Iron and steelmasters, engineers, and manufacturers here commend the decision, especially as it ensures both quantity and price to the latter. They are prepared to grapple with the problems which the change of conditions will no doubt present to many, and they await development of the situation. Producers of iron and steel are disinclined for the moment to do anything to disturb the basis of values, and business transacted this week has been generally done at the prices ruling a week ago. It is too early yet to expect any new currents of demand, but inquiries are anticipated in the very near future. There are, unfortunately, still large stocks of Continental material to be absorbed before recourse is made to the output of native makers, but it is felt that the foreigner will now have considerable difficulty in securing orders and that when fresh supplies are required, they will be obtained from Midland producers. Business should very definitely improve in the iron and steel industries of this area.

Raw Iron.

Midland brands of pig iron continue to be produced a little in excess of consumptive requirements, but furnacemen realise that present stocks would soon disappear if trade improved notably, consequently they are not overconcerned regarding them. Specifications this week have been about on a par with those of recent weeks, but there are few new contracts being given out at the moment. Possibly more will be done in this direction as the quarter draws to a close at the end of this month, for there are some contracts nearing completion. The proposal to tax imported pig iron does not affect this district vitally, since the cost of transport of foreign iron from the coast has been sufficient to rule out any question of competition. Midland makers, however, who sell to consumers in Scotland and the North have had to face competition of this sort, and from that point of view they are interested in the proposal. There is no change in selling prices of local iron. Derbyshire and North Staffordshire No. 3 foundry sells at £3 6s. and forge at £3 1s.; Northamptonshire No. 3 foundry is £3 2s. 6d., and forge iron £2 17s. 6d., all per ton delivered Black Country stations.

Manufactured Iron.

There is no variation from recent weeks in trade conditions in the finished iron industry in Staffordshire. Marked bar makers are better employed than those in other branches, but producers of iron strip have moderately good order books, and are making a reasonable output. Less is now heard of the price-cutting tactics adopted by some firms in the Crown bar branch, and values have settled down on the lower level of recent quotations. Crown iron is quoted from £9 upwards. Some Staffordshire makers ask fully £9 15s. and refuse offers of business at less. Best grade marked bars are firm at £12 per ton at makers' works, while wrought iron tube strip stands at £10 10s. upwards delivered. Nut and bolt bars are named at £8 upwards and fencing bars at from £7 15s.

Steel.

At the steel works in this district the situation shows no improvement. It is not notably worse, however, specifications being steady. Local industries which generally can be relied upon to absorb large tonnages of steel are quiet, and current consumptive capacity is below the normal level for the period of the year. Steelmasters on 'Change in Birmingham this week were eagerly searching for either new business or for specifications against existing contracts. Selling prices of finished steel are firm on the basis agreed by the Association. Angles are £8 7s. 6d.; tees, £9 7s. 6d.; joists, £8 5s.; and ship, bridge, and tank plates, £8 17s. 6d.—all less their respective rebates to users confining their purchases to British steel. Boiler plates are steady at £8 7s. 6d. There is no change in the half products branch of the industry. Foreign competition is not so keen perhaps, but the volume of business accruing to district makers is no greater than of late. Values are unaltered. Small steel bars re-rolled from Continental billets are quoted £6 7s. 6d., and all-British bars £7 5s. Mild steel billets range from £5 5s. to £5 7s. 6d. Sheet bars from £5 to £5 5s. Staffordshire hoops remain steady at £9 10s.

Galvanised Sheets.

Competition in the galvanised sheet trade is keen, millowners being very anxious to obtain business. In most instances quotations are kept up to £9 7s. 6d. basis for 24 gauge corrugateds, but transactions take place at anything from £9 5s. to £9 15s., according to specifications, &c. There has been slightly more inquiry from overseas buyers this week, and some useful orders are anticipated. There is no alteration in selling prices of lighter gauge sheets. Black sheets are in moderately good request at recent rates.

Tin-plates.

The reports of the consolidation of the tin-plate pool have had little effect on the Birmingham market. Buyers claim to be able to satisfy their requirements at about 14s. 3d., or even less, though mills quote 15s. Trade demands are so moderate in this district at date that the amount of business passing is small.

Successful Trading.

It is pleasant to record that Manley and Regulus, Ltd., engineers, of Wolverhampton, are able to show a profit on the past year's working of £13,079, and are in the happy position of being able to report that the subsidiary companies have all earned profits as a result of their trading. With a sum of £9028 to bring forward, the directors are able to recommend a final dividend of 10 per cent. on the ordinary shares, making 20 per cent. for the year, and a bonus of 2½ per cent. on the ordinary shares. The company's report states that substantial sums have had to be written off stock values, owing to the continuous heavy decrease in the value of the principal raw materials used in the company's manufactured goods. The suspense account of £5000, which was created last year to meet this possible decrease in value, has not yet been drawn upon, and remains intact to meet further possible fluctuations.

Heavy-Oil Omnibuses.

For about twelve months past two oil-engined omnibuses have been in operation in Birmingham, and now, following upon the report of Mr. A. C. Baker, general manager of the city tramways and motor omnibus department, on their performance, he has been authorised to buy six more vehicles of a similar type. Mr. Baker in his report points out that the great concern is the highly important question of economy. On one of the oil-engined omnibuses a saving of 75 per cent. has been effected, and on the other even more. Mr. Baker mentions the oil engine's added power at low speeds, and says that gear changing is definitely lessened, and this fact lends itself to increased comfort for passengers. While admitting the future possibilities of this new type of engine for omnibuses, Mr. Baker, however, could not envisage the day when there would be a wholesale change-over from petrol to fuel oil in Birmingham. Until a further stage has been reached in the checking of the cost, no sound comparison for wear and tear is possible.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Wages and Mechanical Coal-cutters.

MR. CHARLES DOUGHTY, K.C., who was appointed by the Board of Trade as independent chairman to decide the dispute which had arisen between the Lancashire and Cheshire Coalowners' Association and the Lancashire and Cheshire Miners' Federation on the question of rates of pay for miners working on coal-cutting machinery, has lost little time in making known his decision, for it was only about the middle of last month that Mr. Doughty, privately in Manchester, heard the evidence of both sides. The contention of the miners' representatives was that the rate of pay in connection with the working of coal-cutting machines in the two counties was unduly low in some instances. Mr. Doughty has decided against the miners, and in the course of his decision, which was disclosed last week-end, he states that he is not satisfied that the profits accruing to the employers are such as make it equitable that basis rates should be varied; that in some cases the use of machines enables the employers to work mines, which, otherwise, under present conditions, would be closed down, and that the vast majority of the workmen actually employed at the coal-cutting machines are paid by basis or contract rates which, having regard to the present state of the industry, are not unfair. The inquiry in question was directed to Lancashire and Cheshire, but the effects of the decision are expected to be national rather than local. Much dissatisfaction has been expressed by miners' leaders in this district, and the matter is expected to be further dealt with at a joint meeting in Manchester with the employers.

Railway Workshop Changes.

The recent announcement of the London, Midland and Scottish Railway Company concerning the closing of the Newton Heath, Manchester, carriage works has been followed by various rumours, at present unconfirmed, concerning other of the company's plants in Lancashire and Cheshire. It is reported, in the first place, that certain of the men now employed at Newton Heath will be transferred to the Horwich locomotive shops, where, in future, the repair of the rolling stock employed on the Liverpool-Southport electric line is to be carried out. This work was formerly done at the Newton Heath works, and a large shop at Horwich is said to be in course of preparation for the purpose. New motor bogies are also to be built at Horwich. Other reports that have been in circulation during the past week are to the effect that the Horwich steel works are to be closed down and that four departments—the steel-smelting plant, the rail mills, furnaces and forges—at Crewe are also to be closed.

Lancashire and Cheshire Developments.

Several industrial developments in Lancashire and Cheshire, either in actual operation or on the point of being started, are largely the consequence of the British tariff on imported products. At Burnley, a new company, English Insulated Machines, Ltd., is carrying on the manufacture of machines for making cotton, silk, and rubber insulation. These machines were formerly imported from France. It is also hoped to start shortly the manufacture of elastic braid-making machines. The demand for British elastic goods has benefited from the tariff, and it is proposed to produce here the necessary plant. Textile plant from a French mill is being transferred to Mossley, where the French concern is starting up two mills that have been idle for some time, whilst at Knutsford, in Cheshire, machinery is being shipped from Holland for the purpose of carrying on the manufacture of waxed paper. In these two cases the machinery has been transported direct *viâ* the Zeebrugge-Harwich train ferry.

Profits Down.

For the twelve months to the end of March last, the profits of West's Gas Improvements Company, Ltd., gas engineers, of Miles Platting, Manchester, amounted to £30,094, against £37,421 in 1930–31. The year's distribution on the ordinary share capital is 10 per cent., compared with 12½ per cent. in each of the two previous years.

Non-ferrous Metals.

Much the most important event in the non-ferrous metals market during the past week has been the failure of a leading London firm on the tin market. This led to a temporary suspension of trading in the metal.

Tin prices are, therefore, largely nominal at the moment, though the latest quotations posted at the time of writing represent a fall on balance in the region of £3 10s. per ton. Prior to Monday's announcement of the failure, moderate trading had been reported in tin, and on the strength of a reduced world production, coupled with a slight improvement in the statistical position, the outlook was deemed to be a little more promising. The demand for copper from consumers of the metal has remained rather poor, and quotations for standard brands are about 10s. per ton lower on the week, with refined descriptions correspondingly cheaper. A recovery to the extent of nearly 10s. per ton has wiped out part of the previous week's loss in spelter, and at the moment the tone of this section of the market is fairly steady, with inquiry on a moderate scale. A fair trade has been reported in lead, and the prices ruling a week ago in respect of this metal are being quoted at the moment of writing.

Iron and Steel.

Quiet conditions are being experienced in most departments of the iron and steel trade in this area, with the cheap supply of scrap having a definitely unsatisfactory effect on the movement of foundry iron, a number of users employing a much larger proportion of scrap material than normally. Current sales of pig iron are limited and very little forward buying is reported, whilst aggregate deliveries locally are showing some slight contraction. Prices are steady, however, with Derbyshire, Staffordshire, and Cleveland No. 3 all quoted for delivery in the Manchester area at 67s. per ton, Northamptonshire at 65s. 6d., Derbyshire forge at 62s., Scottish No. 3 at about 86s. 6d., and West Coast hematite at 81s. Lancashire Crown bars are still quoted at £9 15s. per ton, and best bars at £10 5s., with business slow. There has been little improvement in the rate at which steel is being taken up locally, with the demand from constructional engineers still the weakest spot so far as the bulk trade is concerned. Joists are at £8 15s. per ton, sections at £8 7s. 6d., ship and tank plates at £8 17s. 6d., 3in. and upward bars at £9 7s. 6d., small re-rolled bars at from about £6 15s. to £7 per ton, according to quantity, and boiler plates at about £8 12s. 6d. for both acid and basic descriptions.

BARROW-IN-FURNESS.

Hematite.

The pig iron market remains about the same, but there is a tendency to take a slightly better view of the future. It will take time for better trade to develop, but it is thought that as soon as there is a turn it will certainly be for the better, and this district will immediately benefit. The foreign trade at present is moderate, and the home demand has not lifted at all, but foreign stocks are by no means exhausted yet. When they are it will be time to test the effect of the new duties. Iron ore remains about the same, and until there is a bigger outside demand the position will remain the same. In the steel market there is just the prospect of better things. The L.M.S. is reported to have decided to close down its steel department at Crewe, and this will probably mean that Barrow will receive more contracts which will be shared with Workington. The fact that both works are on the L.M.S. system means that all iron and steel used in manufacture tends to increase the traffic on the railway, and this fact, no doubt, influences the placing of orders in this district.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Re-organisation.

SHEFFIELD steel manufacturers have welcomed the assurance given by the Import Duties Committee that the industry will obtain protection as long as is necessary provided the producers satisfactorily carry out their obligations to consumers. It is realised that reorganisation will be necessary in some instances, but rationalisation and modernisation have been undertaken by so many large firms locally during recent years that there is nothing to fear in this respect. There have been drastic restrictions and elimination of duplication, so that the efficiency of the big works is higher to-day than ever before, and a striking feature of their operations is the special attention paid to research and metallurgical investigations.

The Latest Fusion.

In view of the Import Duties Committee's announcement, special importance is attached to the announcement of an agreement between Stewarts and Lloyds, Ltd., and the United Steel Companies, Ltd., the latter concern's headquarters being in Sheffield. A joint statement made by the two companies explains that the new situation brought about by the imposition of tariffs encourages and requires undertakings in the steel and complementary trades to plan for the future and to enter into arrangements having for their object the economic development of the industry and the prevention of overlapping and duplication of plant for those markets where the productive capacity is already fully sufficient for the demand. The two companies have agreed to co-operate in the policy of extensions in steel production, avoidance of uneconomic duplication of plant, sales policy, research, technical development and production methods. The importance of the agreement is emphasised by the greatness of the two undertakings. The United Steel Companies, Ltd., manufacturers of iron, steel and allied products, incorporates Steel, Peech and Tozer, Ltd., The Ickles, near Sheffield; the Workington Iron and Steel Company; Samuel Fox and Co., Ltd., Stocksbridge, near Sheffield; Daniel Doncaster and Sons, Ltd., Sheffield; Frodingham Iron and Steel Company, Ltd.; the Appleby Iron Company, Ltd., North Lincs.; the Rother Vale Collieries, South Yorks.; the United Strip and Bar Mills, The Ickles; Thomas Butlin and Co.; and the United Coke and Chemicals Company, Ltd.

District Works' Position.

The firm of J. Beardshaw and Son, Ltd., of Baltic Steel Works, Sheffield, has acquired from the liquidator the works and goodwill of John Willey and Sons, Ltd., Norfolk Bridge forge and rolling mills, Sheffield. It is reported that at the Redbourn Hill works, Scunthorpe, money is being spent on putting furnaces and coke ovens in order, and local steelworkers who are unemployed are hoping that the works will be reopened soon, although no official announcement has been made on the matter.

Railway Work.

Although departments concerned with the production of railway material, axles, tires, springs, &c., are very poorly employed at the present time, there is a hope of more work being obtained. In this connection importance is attached to the announcement that the London, Midland and Scottish Railway Company contemplates closing down the steel-making departments of its works at Crewe, although this plant was enlarged and modernised only a few years ago. Local manufacturers have felt a grievance that railway companies should produce their own steel materials, contending that these could be bought more advantageously. Now it is hoped more valuable orders will come to Sheffield.

High-pressure Drums.

Thos. Firth and John Brown, Ltd., Sheffield, have been pioneers in the manufacture of hollow-forged weldless steel drums for high-pressure steam boilers, and at the present time are executing important and interesting orders involving this type of work. One of the jobs is the manufacture of a reaction chamber for oil refining, the biggest ever made in this country, for the Trinidad Leaseholds, Ltd. The inside diameter of this drum will be 6ft., the thickness of the walls 3¼in., and the overall length nearly 50ft. The finished weight of the chamber will be in the neighbourhood of 70 tons, and the weight of the ingot required for the purpose was 160 tons. The test pressure of the chamber will be about 2000 lb. per square inch. The firm is also making a high-pressure boiler drum, similar to three previously supplied for the Ford works at Dagenham. This is made from an ingot which weighed 156 tons when cast. Also a reaction chamber is being made for the Anglo Persian Oil Company. The finished weight of this will be 51 tons, and the test pressure will be 3000 lb. per square inch.

Gas Company's Feat.

As a result of the abnormal rainfall and consequent floods experienced recently, the supply of coke-oven gas to the Sheffield Gas Company was seriously interrupted, and for a considerable time the company was able to obtain only 25 per cent. of the normal quantity. Steps were immediately taken to bring auxiliary plant into operation and strenuous efforts resulted in the full supply of gas to the consumers in Sheffield being maintained. Actually, consumers were not in the least inconvenienced, despite the fact that the full supply of gas to the company's works was not restored until a week after the first stoppage.

Ewden Reservoirs Work.

An important statement by Mr. J. K. Swales, general manager and engineer of the Sheffield Waterworks Department, definitely disproves certain rumours that serious movements of material have occurred at the Broomhead reservoir of the Sheffield Corporation in the Ewden Valley. It is stated that despite the effect of the recent heavy rains, nothing extraordinary or really unexpected is occurring at Broomhead. Remedial work undertaken, following "slips" which began in 1924, and have seriously interfered with the construction and completion of the reservoir, has not yet been finished. There have been slight movements during the past eighteen months, averaging from $\frac{1}{16}$in. to $\frac{1}{8}$in. per month, but these have been in parts of the works which have not yet been touched by the remedial measures. The engineers are confident that substantial and satisfactory progress is being made towards a sound solution of the difficulties which have been experienced. It will be recalled that towards the end of 1930 experts presented a report on the state of the Ewden reservoirs and made recommendations upon which the scheme of remedial work since undertaken was based. Bore-holes have been sunk and thousands of tons of cement have been injected into the floor of the Broomhead reservoir.

NORTH OF ENGLAND.

(From our own Correspondent.)

Teesside's New Industry.

A NEW industry on Teesside gives promise of substantial development and of giving work to a good number of men. This is the Cleveland Steel Casements Company, Ltd., which has been promoted by the management of the Middlesbrough Ship Repairing Company, a firm of many years' standing in the town. A large sum of money has been spent in acquiring machinery, and a start was made this week in producing steel window frames of every shape and design. While the manufacture of steel window frames has already been undertaken in the Midlands and the South, the Cleveland Steel Casements Company is breaking new ground so far as the North-East Coast is concerned. With the advantage of obtaining steel on the doorstep, and with the excellent shipping and transport facilities, the Middlesbrough enterprise should be able to compete on favourable terms. British and foreign agents have been appointed for the marketing of the products, which will be manufactured of local steel, and all bars will be joined by welding.

Coke-cleaning Plants.

The Birtley Company, Ltd., has obtained three further large contracts for the supply and erection of coke-cleaning plants. One contract is from the Writhlington Collieries, Ltd., near Bath; another is for the Craghead Colliery, of the Holmside and South Moor Collieries, Ltd.; and the third is from Czechoslovakia. The plant for the Craghead Colliery is a repeat order. The Birtley Company have this year secured eight important contracts for their special process of coke cleaning.

Cleveland Iron Trade.

Although the market is still quiet, there has been a slight acceleration of business during the past few days; and confidence has been strengthened by the declared intention of the Tariff Advisory Board to continue the protective duties during the period of reorganisation of the industry. Producers now look hopefully forward to a gradual expansion in the home trade, and although chiefly confined to early delivery, a few more orders have been booked. The export trade, unfortunately, is very quiet indeed, and little hope is entertained of early improvement in that direction. Ironmasters are still selling to Scotland, but only on terms which they refuse to accept elsewhere. No. 1 Cleveland foundry iron is 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s.

Hematite Pig Iron.

In the East Coast hematite pig iron trade a better demand has developed, but competition is very keen, and in some cases sellers are cutting below the quoted price of 63s. for mixed numbers. Another cargo of 1000 tons has been shipped to South Wales.

Iron-making Materials.

Foreign ore is almost unsaleable, though sellers would shade the quoted figure of 15s. for best Rubio, c.i.f. Tees. The ironworks being largely self-supporting in the matter of fuel supplies, there is a very limited demand for blast-furnace coke at 15s. 6d. delivered at the works.

Manufactured Iron and Steel.

There is very little change in the manufactured iron and steel trade, orders being limited to small tonnages for early delivery, and prices are all unchanged.

Iron and Steel Imports.

Returns presented at this week's meeting of the Tees Conservancy Commission showed that only 7738 tons of iron and steel were imported into the Tees last month, as compared with 14,490 tons in May, 1931 and 5016 tons in May, 1914. For the seven months since November, 90,126 tons have been imported, as against 96,363 tons during the corresponding period of 1930–31. There is a big drop in pig iron imports, only 860 tons being brought into the river in May, compared with 3881 tons in May last year and 75 tons in May, 1914. For the seven months since November, 6983 tons were imported, as against 16,782 tons in the corresponding period a year ago. Of this total of 6983 tons, 6232 tons were imported coastwise.

The Coal Trade.

The restrictions on imports of coal into the near Continental countries and the substantial stocks at most importing centres in Scandinavia as well as Italy, are seriously affecting the fuel position in the North of England. The home demand from the large consuming centres of gas coal is also at a low ebb, with the result that the lack of new business in the Durham coal section is pronounced. Many pits are idle in Durham, and included in these are some of the first-grade coal mines. Merchants, owing to the fixed minimum price scale, cannot cut prices to compete against Polish and German owners. The Lithuanian State Railways authorities have invited offers for the supply of 50,000 tons of prime locomotive coal to be shipped in monthly quantities to named ports during August to March. The stipulated shipments are to be in carriers of about 3000 tons each, and the monthly portions 7000 to 10,000 tons. Durham used to get this business, but more recently Poland has successfully competed for the contract. The Northumberland steam coal trade is quiet. Sellers offer all descriptions readily, but buyers are holding off. Several grades are being reduced in output by short-time working or the closing down of some of the pits or seams, but there is no scarcity, and prices remain easy for prompt or forward. Large steams are quoted at 13s. 6d., and small at 8s. 6d. The latter are somewhat sparingly offered owing to possible limitation of output. Prime Wear steam coals are quoted unchanged, but are easy in tone, large at 15s. and small firm at 12s. Tyne prime are steady for best at 12s. 9d., and small at 9s. No section of the Durham coal trade is active, but the position is no worse. Bunker coal for early clearance is in better demand, and, although plentiful, is quoted steady at 13s. to 13s. 6d., according to individual brands. Gas coal is in quiet demand at 14s. 6d. for best kinds and 13s. to 13s. 6d. for second qualities. Coking unscreened and small move slowly at from 12s. to 13s. 9d., according to brand. There is no animation in the coke demand, and although stocks of all classes are plentiful, owners quote steadily at recent prices, and failing buyers at these prices prefer to increase stocks. Gas coke is in quiet demand at 17s. 9d., patent oven coke is abundant and easy at 14s., and superior foundry coke and also coke nuts are at 16s. to 18s.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THE output from Clyde yards during May was the largest for any month this year to date. Four vessels, aggregating 11,400 tons, were launched, including two cargo steamers, one river passenger steamer, and a torpedo-boat destroyer, H.M.S. "Dainty." The normal post-war average for May is round about 30,000 tons, and the five months' total 180,000 tons. This year to date the aggre-

gate output is 25,000 tons. One or two inquiries have been maintained, but the only firm order reported during May was one secured by Scotts, Greenock, on behalf of the China Navigation Company, London. During the past week, however, the Burntisland Shipbuilding Company received an order to build a steamer from the Wandsworth and District Gas Company. The vessel will be slighty over 2000 tons deadweight. Last week-end Lobnitz and Co., Ltd., Renfrew, launched a vessel which will be the most powerful tug operating in the Southern Hemisphere. The tug is 130ft. in length, 32ft. in breadth, with a depth of 15ft. The designed speed is 12 knots and the pull on a tow-rope one of 12 tons.

Steel.

The chief item of interest this week is the announcement of an important scheme for co-operation between Stewarts and Lloyds, Ltd., Glasgow, and the United Steel Companies, Ltd., Sheffield. By the arrangement the companies agree to co-operate in the policy of extensions in steel production and avoidance of uneconomic duplication of plant, in research, technical development, and production methods, and also in sales policy. It is also of interest to note that it is understood that Stewarts and Lloyds have within recent months discussed a proposition for the erection of plant at Corby, Northants, for the manufacture of basic Bessemer steel.

Steel Sheets and Tubes.

Steel sheets are comparatively quiet at the moment. Light black sheets have better support than heavy grades. Galvanised sheets are only moderate. There is a fair inquiry at present especially from Canada, but advices from the Far East are more hopeful. The tube trade is not making much headway in the meantime

Iron.

Producers of bar iron have a very restricted turnover on both home and export account, owing, in a measure, to competition from Continental material and the cheaper cost of home steel. Re-rollers are, perhaps, a little better off in steel bars and small sections, but hoops are rather poor. Re-rolled steel is quoted £6 10s. home and £6 7s. 6d. per ton export.

Pig Iron.

It is understood that an import duty will be imposed on pig iron in advance of the Import Duties Committee's main recommendations bearing on the iron and steel industry. In the past few months the largest proportion of imported pig iron has come from India, Continental material having been affected by the fall in sterling. Meanwhile, the output from the six local furnaces is quite sufficient to meet all demands.

Coal.

Supplies of most descriptions of Scottish fuel are ample. Lanarkshire collieries are affected by the drop in home requirements, and prices for the most part are a matter of arrangement. Lothians steams are not too strong, but Fifeshire first-class are firmly held. Treble nuts are well placed in all districts, but smaller sizes are inclined to weaken. Aggregate shipments amounted to 229,494 tons (of which 166,185 tons went in coastwise directions and the remainder foreign), against 230,579 tons in the preceding week, and 186,199 tons in the same week last year. Tenders have been forwarded for the supply of 175,000 tons of first-class steam coal and 5000 tons bunkers for the purposes of the Swedish State Railways during the period July-November. It has been intimated that a Fifeshire coal company was prepared to cover 50,000 tons of Cowdenbeath at 12s. 3d. per ton and Aitken at 13s. 6d. per ton.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

IT would be difficult to say that the conditions in the steam coal trade are generally better; yet it is true that they are certainly no worse, and if tonnage was obtainable to fulfil a number of the prompt orders that are on the market, the situation of many collieries would be distinctly improved. As almost invariably happens when the outward freight market makes a move upward, new orders come along. Buyers abroad suddenly make up their mind that they had better secure supplies before c.i.f. prices advance further, and the result is that there are more orders on the market for small cargoes than for some time past, and those merchants who sold even a week or so ago, now find that the sharp rise in outward rates of freight for Mediterranean destinations, in particular, is responsible for their business becoming very unremunerative. It is a fact that for some directions outward rates of freight have advanced 1s. to 1s. 6d. per ton as compared with a month ago, this being to a large extent due to the scarcity of homeward business. The trouble now for merchants is to work off these orders which are landing them in losses, as prompt steamers are very scarce, and meantime the position of the collieries is that while on paper they are well stemmed, in certain cases, yet they are badly in need of the tonnage which should be placed at their disposal. Still, according to the returns of the Great Western Railway Company, shipments of steam and anthracite coals at the principal ports last week came to 435,000 tons, as compared with 407,295 tons for the preceding week and with 504,747 tons for the corresponding period of last year. Good loading work was accomplished on individual steamers, and on Saturday returns showed that at the various docks the number of vacant loading berths was as high as forty-six. The position on Monday, as the result of week-end arrivals, was that the number of vacant berths was reduced to thirty-one, and there were no less than nine steamers waiting to berth at Swansea and Port Talbot, where the loading pressure continues to be active. New business on the market for substantial supplies of coal is without feature, except that it may be said that the Paris–Orleans Railway of France is negotiating with local firms for about 100,000 tons of large coal for delivery during 1933 and 1934. The Algerian State Railways are also in the market for 60,000 tons of patent fuel for delivery during the second half of this year at Algiers and other ports, but it may be some weeks before this business is placed.

S.W. Coal Audit.

Last week details were issued by the Secretary of the South Wales Coalowners' Association of the audit for the three months ended April last. They show that there was no improvement in the coal trade during that period, the report of the accountants certifying a percentage wage on basis rates of 3·83, compared with 2 per cent. for the previous quarter. The minimum percentage payable by the coalowners is 20 per cent. on the basis rates, so that the coalowners have to shoulder the difference between this percentage and that of 3·83 as certified by the accountants. The average proceeds per ton were practically the same as in the previous three months, but there was a slight fall in the cost of production, and, mainly for this reason, the audit shows a credit balance of £91,554, equal to 2·49d. per ton. The most disquieting feature, it is pointed out, is the continued fall in the volume of trade. Calculated on a yearly basis the output for the three months ended last April, viz., 9,543,000 tons, represents a decrease of approximately 20 million tons compared with 1913, and puts back the industry to the production position of 1901, thirty-one years ago; while exports at 3,990,000 tons for the three months ended April last, when calculated on a yearly basis, show, compared with the pre-war year, a decline in volume of 14,000,000 tons, equivalent to a sum of about £12,600,000, irrespective of freights.

Iron and Steel Trade.

The announcement at the end of last week of the setting up of a National Committee to work out schemes for the reorganisation of the iron and steel industry, in consideration of the acceptance of which by the industry, the existing tariff of 33⅓ per cent. will be continued indefinitely, is regarded in this district as a welcome step, and gives hope of the revival of activity at the various large works. Leading steel makers agree, however, that it is too early to make predictions as to the effect of the present move. The position at the Ebbw Vale works was again discussed at a meeting of the Ebbw Vale Town Development Committee on Monday, when it was decided to write to Sir John Beynon, the chairman of the Ebbw Vale Steel Company, requesting him to convey to the committee any new information that was available as soon as possible. Meantime a circular has been sent out by the Ebbw Vale Company to the members of their staff, including the staffs of their collieries, asking them for a voluntary reduction in their remuneration.

Miscellaneous Items.

It was reported to a meeting of the Executive Committee of the South Wales Miners' Federation on Saturday last that a coalfield delegate conference had been called for Saturday, the 18th inst., to consider the general situation, in view of the passing of the measure for the continuance of the 7½ hours' day, and the guarantee given by the owners to maintain present wages for a year. Evidently there is no expectation of sectional action, as the conference is convened to consider the procedure to be adopted by the Federation during the next twelve months. Owing to the refusal of the pitwood workers employed in the discharge of pitwood at Cardiff and Barry to entertain the proposals of the employers for a reduction of overtime rates and the removal of certain anomalies, the Cardiff and Bristol Channel Pitwood Importers' Association at a meeting last week decided to give the workmen one month's notice to terminate the existing agreement on July 1st next. In the meantime the members of the Importers' Association are prepared to meet the men to discuss their proposals further. Penarth, Barry, and Newport tippers have agreed to a reduction of 10 per cent. as from Monday last in the £3 weekly minimum wage, making the minimum £2 14s. Negotiations in respect of the Cardiff, Swansea, and Port Talbot tippers are still proceeding. The 10 per cent. reduction applies only to the minimum wage and not to the tonnage rates on which the men's earnings are calculated. On Thursday last week the Donaldson liner "Concordia" discharged 449 head of cattle from Western Canada at the Roath Dock, Cardiff, this being the first consignment of live cattle from Canada to Cardiff since November, 1930. A second consignment is expected shortly.

Centralising Colliery and Coal Export Interests.

The official announcement was made last week that a provisional agreement for the purchase of the Mardy pits of the Locket's Merthyr Company by the Welsh Associated Collieries, Ltd., has been approved by the court, subject to certain conditions. It was also announced that an agreement had been reached whereby as from the 1st inst. the sales of the export coal produced by the Tirpentwys Black Vein Collieries will be directed by Messrs. Gueret, Llewellyn and Merrett, Ltd. The shareholders of Morgan, Wakley and Co., Ltd., one of the oldest coal-exporting firms in Cardiff having accepted the proposals submitted to them by their board, the control of this company changes hand, and comes under the direction of Gueret, Llewellyn and Merrett, Ltd. The present directors will retire and the new board will be appointed by the purchasers.

Bristol Channel Pilotage.

At a meeting at Cardiff last week of representatives of all the authorities concerned, the question was discussed of reducing the cost of pilotage at Cardiff, Newport, and Barry by some means of amalgamation or co-ordination of the cutter services, or even of the three pilotage authorities of the three ports. It was eventually decided to appoint a committee of the three authorities concerned to consider the possibilities of effecting economies by some form of amalgamation or co-ordination, the committee to consist of not more than five representatives to be appointed by each authority and a practical independent chairman, while of the five representatives to be appointed by each authority at least two shall be pilots. It was agreed that the Chamber of Shipping, in consultation with the United Kingdom Pilots' Association, should be asked to suggest the name of the independent chairman.

Current Business.

Although there is a slight improvement in the demand for some grades of steam coals, the inquiry is not so active as to infuse appreciable steadiness into the market. Dry coals are rather scarce, and command a premium on minimum prices, but other qualities of coal are in excess of requirements. Patent fuel is comparatively well stemmed, but coke shows no improvement. Pitwood is stationary.

A MOTOR BOAT ENGINE.

AN interesting adaptation of the Napier "Lion" aeroplane engine has recently been made by Mr. H. Scott Paine, of the Power Boat Company, Ltd., of Southampton, who has converted the engine into a motor boat unit, which, we learn, will be called the "Sea Lion." Successful bench trials have already been carried out, and it is proposed to install the engine in a high-speed boat for further experimental tests. The marine engine incorporates the usual arrangement of three banks of cylinders in the form of a broad arrow, and it has a designed output of 500 H.P. at 2300 r.p.m., the power-weight ratio being 2·6 lb. per horse-power developed. It is proposed to offer it in three ratings of 500, 425, and 400 H.P. respectively, under which running conditions it is expected that 300 and more hours of continuous service will be able to be guaranteed without overhaul. The principal modifications include a different design of water-cooling pipes, and carburetters, and the extension of the crank shaft journal in order to carry the new reverse and starting gears. The new "Sea Lion" will be one of the most powerful motor boat engines produced in this country, and it should prove a useful unit in the growing British export trade in fast motor craft, both for Government services and for commercial work.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE WALLSEND SLIPWAY AND ENGINEERING COMPANY, Ltd., informs us that Mr. Thomas McPherson, general manager, has been elected to a seat on the board.

MR. E. J. FOX, managing director of the Stanton Ironworks Company, Ltd., near Nottingham, has been elected chairman of the Council of the Society of British Gas Industries for the coming year.

UNDER the style of Escher Wyss Engineering Works, Ltd., a new company has been formed and has taken over the operation of the Société Anonyme des Ateliers de Constructions Mécaniques Escher Wyss et Cie., of Zurich. The board of directors comprises Mr. Th. Wolfensperger, bank manager, Zurich, president; Dr. A Böckli, bank manager, Basle; Dr. Ing. h. c. H. E. Gruner, Basle; Mr. H. Gut, assistant bank manager, Zurich; Mr. M. Müller-Koller, Zurich; Mr. E. Payot, bank manager, Basle. The management of the company consists of:—General manager, Mr. A. Huguenin, M. Inst. C.E.; managers, Mr. H. Guyer and Mr. A. Maas; works manager, Mr. V. Frey.

CATALOGUES.

GRAHAM AND NORMANTON, Exmoor-street, Halifax.—Sheet XL, illustrating some of the firm's lathes, shaping machines, and boring machines.

ELECTRO-DYNAMIC CONSTRUCTION COMPANY, Ltd., Devonshire-grove, S.E. 15.—A descriptive price list of polyphase variable-speed motors.

STURTEVANT ENGINEERING COMPANY, Ltd., 147, Queen Victoria-street, E.C. 4.—Publication No. 1070, on propeller fans and small ventilating sets.

L. GARDNER AND SONS, Ltd., Patricroft, Manchester.—Catalogue No. 521, dealing in detail with the L.W. type high-speed oil engines for road transport.

RENOLD AND COVENTRY CHAIN COMPANY, Ltd., Didsbury, Manchester.—A booklet illustrating a large selection of driving arrangements possible with chain gear.

BRITISH ALUMINIUM COMPANY, Ltd., Adelaide House, King William-street, E.C. 4.—A 140-page book illustrating and describing steel-cored aluminium transmission lines.

SIR W. G. ARMSTRONG, WHITWORTH AND CO., Ltd., Close Works, Gateshead-on-Tyne.—A book on the uses of "New Process" iron for high-duty grey and malleable iron castings.

D.P. BATTERY COMPANY, Ltd., Bakewell, Derbyshire.—Publication on the Kathanode traction cells for locomotives, trucks, &c. Also a folder on batteries for operating sand equipment in mines.

IGRANIC ELECTRIC COMPANY, Ltd., 149, Queen Victoria-street, E.C. 4.—Leaflet No. 8 on "Direct Current;" No. 9, "Motor Starting Switches;" No. 149, "Panel Type Starters and Controllers;" No. 1080, "Self-acting Starters."

AN interesting function took place at the Basingstoke works of John I. Thornycroft and Co., Ltd., on the termination of the engagement of Mr. Norman Endacott as works manager. Mr. Endacott joined the Thornycroft firm in Chiswick in 1896, on leaving the Finsbury Technical College, and therefore entered the motor industry almost at its birth. When the Basingstoke works were being built in 1899 Mr. Endacott was sent from the Chiswick motor works to install the plant, acting as foreman when the plant was started. In 1900 he became assistant works manager, and on the retirement of Colonel H. Niblett, Mr. Endacott was appointed works manager, which position he occupied until last week. The staff desired to make a presentation to Mr. Endacott, but the whole of the employees insisted on joining in, and on the cessation of work on Tuesday, May 31st, Mr. Tom Thornycroft presided over a meeting in the works canteen, and presented Mr. Endacott with a gold watch and chain, together with a fitted travelling case.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/6 to 20/–
(1) Spanish	17/– to 22/6
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	15/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 3 0	3 3 0
No. 1	3 3 6	3 3 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (a)	—
	4 0 6 (b)	—
	4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 0 0 to 9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 10 0	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	10 15 0	10 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	8 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 12 6	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 5 0 to 7 15 0	—
Small Re-rolled Bars	6 7 6 to 6 10 0	—
Billets and Sheet Bars	5 5 0 to 5 7 6	—
Galv. Sheets, f.o.b. L'pool	9 5 0 to 9 7 6	—
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 7 6 to 8 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	14/6 to 15/0
Block Tin (cash)	115 5 0
„ (three months)	117 15 0
Copper (cash)	26 5 0
„ (three months)	26 5 0
Spanish Lead (cash)	9 16 3
„ „ (three months)	10 2 6
Spelter (cash)	11 17 6
„ (three months)	12 2 6
MANCHESTER—	
Copper, Best Selected Ingots	30 0 0
„ Electrolytic	32 0 0
„ Strong Sheets	39 0 0
„ Tubes (Basis Price), lb.	0 0 9½
Brass Tubes (Basis Price), lb.	0 0 8¾
„ Condenser, lb.	0 0 11
Lead, English	12 0 0
„ Foreign	10 5 0
Spelter	12 0 0
Aluminium (per ton—raw ingots)	£95

FERRO ALLOYS.

Tungsten Metal Powder	2/3½ per lb.	
Ferro Tungsten	2/– per lb.	
	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c to 6 p.c. carbon	£25 12 6	7/6
„ „ 6 p.c. to 8 p.c.	£24 10 0	7/–
„ „ 8 p.c. to 10 p.c.	£23 15 0	7/–
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£37 10 0	12/–
„ „ „ 1 p.c. carbon	£47 7 6	14/–
„ „ „ 0·70 p.c. carbon	£52 0 0	14/–
„ „ „ carbon free	1/1 per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 15 0 scale 5/– per unit	
„ „ 75 p.c.	£18 7 6 scale 7/– per unit	
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£250 to £255	
Ferro Cobalt	5/3 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/–
„ „ Ell	14/3
„ „ Splint	14/3 to 15/6
„ „ Trebles	11/6
„ „ Doubles	9/9
„ „ Singles	8/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	12/–
„ „ Jewel	16/6
„ „ Trebles	12/–
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	11/– to 13/–
Screened Navigation	16/6
Trebles	13/– to 14/6
Doubles	10/6 to 11/–
Singles	8/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	11/– to 11/6
Secondary Steam	11/–
Trebles	12/6
Doubles	10/6 to 11/–
Singles	8/9

(8) N.W. COAST— ENGLAND.

Steams	21/9
Household	32/6 to 51/8
Coke	20/– to 22/6
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/3 to 12/6
Steam Smalls	8/6
Unscreened	12/6 to 13/–
Household	27/– to 39/–
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/– to 37/–
Foundry Coke	24/–

SHEFFIELD—	Inland.	
Best Hand-picked Branch	25/– to 26/–	—
South Yorkshire Best	20/– to 21/–	—
Derbyshire Best Bright House	20/– to 21/–	—
Screened House Coal	16/– to 17/6	—
Best Screened Nuts	16/– to 17/–	—
Small Screened Nuts	13/6 to 15/6	—
Yorkshire Hards	16/– to 18/–	—
Derbyshire Hards	16/– to 18/–	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	7/– to 8/6	—
Smalls	4/6 to 5/6	—
Blast-furnace Coke (Inland)	11/– to 12/– on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b., 14/6 to 16/6		

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/– to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/–
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/– to 13/6
Ordinary Smalls	11/– to 13/–
Washed Nuts	19/– to 25/–
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/– to 16/–
No. 2 „ Large	17/– to 17/3
„ „ Through	15/6 to 16/–
„ „ Smalls	14/– to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/– to 18/–
Patent Fuel	19/– to 20/–
Pitwood (ex ship)	18/6 to 20/–
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	36/– to 38/6
Seconds	27/– to 32/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 48/6
Nuts	40/– to 48/6
Beans	28/6 to 32/6
Peas	19/6 to 21/–
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/3 to 8/9
Steam Coals:	
Large	20/– to 20/6
Seconds	18/– to 20/–
Smalls	11/6 to 13/–
Cargo Through	16/– to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/– if home consumers confine purchases from associated British Steel Makers. (e) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Trade Restrictions.

THE import quotas, tax on imports, compensating tax, and other methods adopted for the temporary protection of home industries have given rise to complications that may modify the future trade policy, for while industries are saved from the effects of dumping, they are really not much better off when there is very little for them to do in the home market. The partial shutting out of cheap foreign goods has saved manufacturers from ruinous competition, and the import quotas will be maintained until they can be replaced by some international agreement; but as France is an agricultural country, and as the quotas apply more particularly to produce, the result has been to maintain and even increase the cost of living at a time when it is falling elsewhere. The agricultural population complains of impoverishment, and wage earners are getting less because there is less work, so that all classes are reluctant or unable to spend money on manufactured goods, and industries are therefore suffering primarily from a reduced purchasing power amongst an agricultural community, forming the great majority of the population, which is deprived of its main source of prosperity by the closing of foreign markets. There is a strong reaction in many countries against the French policy of import restrictions, and the situation has become so unsatisfactory that opinion is tending in favour of measures of a more liberal character, particularly in the way of offering adequate compensation to countries removing embargoes on French goods. It is believed that the new Government will take another line of action and do what it can to facilitate foreign trade. Already there are negotiations for giving a more elastic character to the import quota system. A strong impression has been made by the decision of Switzerland to retaliate against the 6 per cent. import tax, on the ground that it is contrary to the spirit of existing treaties of commerce. Meanwhile, there is trouble with Belgium, where it is said that French steelmakers are dumping steel. The French do not deny that they are offering steel in that country at low prices, but they say that such competition would not have been possible had Belgian producers adhered to the Steel Cartel. It is now affirmed that the Belgians are making great efforts to come to an agreement amongst themselves so that negotiations for the Steel Cartel may be completed.

Association Technique Maritime.

The Association Technique Maritime et Aéronautique, 7, rue de Madrid, Paris, held its annual meeting last week, when thirty communications were presented on questions interesting marine and aviation authorities, notably on hull forms, cavitation, the theory of propellers, calculations relating to rolling and pitching, structural stresses, experiments with the use of tar oil in solid-injection engines, and other matters. One paper was by Monsieur Oehmichen, on his new form of "helicostat," which was tested successfully during the past two years. In that communication the author gave results of experiments carried out with lifting screws, which led him to adopt inclined screws on a partially buoyant machine with a gas bag. The defects of the true type of helicopter were, he said, entirely overcome by the new apparatus, because the gas bag, while not cumbrous and offering little resistance to the air, gave handiness to the machine which had remained stationary for 30 minutes at a height of 300 m., had landed in a wind at the precise spot it had started from, had turned right round in a radius of 10 m. and had demonstrated its ease of handling and safety in other ways. The 40 horse-power engine provides a maximum lifting effort of 200 kilos. and the gas bag 230 kilos. Monsieur Oermichen is convinced that the "helicostat" with gas bag and variable inclined propellers is capable of being developed into a perfectly safe and economical commercial machine. Captain Jouglard, Chief Engineer of the Corps de l'Aéronautique, dealt with the advantages and drawbacks of airships from a military point of view, and, while reserved in his conclusions, was nevertheless of the opinion that close attention should continue to be given to the airship, which, he said, showed high efficiency at a point where all other existing air machines began to lose theirs.

A Super Air Extractor.

Amongst the difficulties experienced in working the Claude-Boucherot system of obtaining energy from warm sea water is the extraction of air from the huge mass of water, the quantity of air per horse-power being about 200 times that dealt with normally in a heat power plant. In order to solve this problem the late Monsieur Rateau established the conditions of a centrifugal air extractor working with an admission of 9 cubic metres a second and a compression of about 100, the energy absorbed being approximately 250 horse-power. The machine has now been completed at the La Courneuve works. The first wheel of the centrifugal machine has a peripheral speed of 400 m. a second, and it is hoped to utilise this high velocity in elucidating problems relating to aero-dynamics.

The Saint-Gothard Tunnel.

There have been official and popular manifestations in Switzerland during the past week to celebrate the fiftieth anniversary of the completion of the Saint-Gothard tunnel. That undertaking, which prepared the way for communication through the Alps to all parts of Europe, was particularly arduous on account of the frequent flooding of the galleries. Work on the tunnel was begun at the two ends in June, 1872, and it took just ten years to complete it, during which time 2500 men were constantly employed and 60 per cent. of them were attacked by fevers and other diseases, from which 200 succumbed, including Monsieur Louis Favre, the engineer who was responsible for the undertaking and carried it through to within three years of its completion under extraordinary difficulties.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

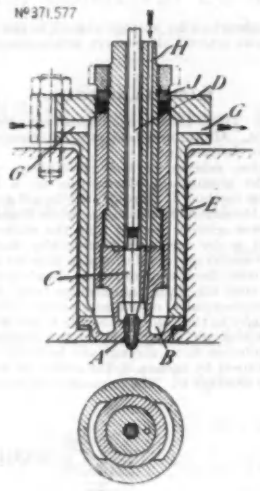
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

371,577. April 7th, 1931.—FUEL INJECTORS, Maschinenfabrik Augsburg-Nurnberg A.G., 7, Stadtbachstrasse, Augsburg, Germany.

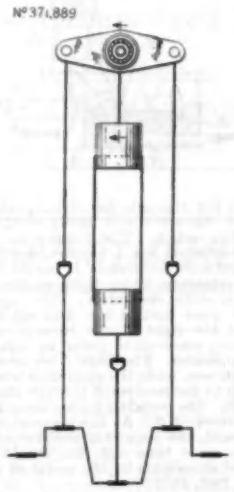
This nozzle is intended for the solid injection of fuel under pressures of 300 atmospheres or more. The nozzle proper A has a conical seating, which is made a tight fit in the carrier B.



Its top face is ground true, and co-acts with the end of the needle C, which is guided in an extension of the carrier B. The needle is actuated by the separate loose spindle D. The whole assembly is held in place by the casing E bearing on the flange of the carrier B. Cooling water is supplied to the jacket through the branches G G, and the oil fuel by the passage H. A stuffing-box is provided at J.—*April 22nd*, 1932.

371,889. April 29th, 1932.—OPPOSED PISTON ENGINES, W. Doxford and Sons, Ltd., and K. O. Keller, Pallion Yard, Sunderland.

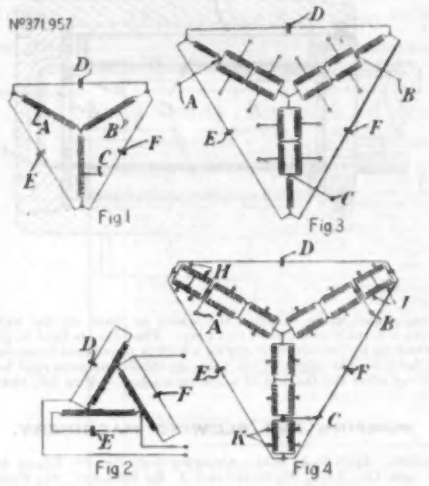
It is stated in this specification that there is a tendency for the cylinder liner in which the top piston works to wear excessively on account of vibrations transmitted to the piston by its yoke and connecting-rods. In consequence, the inventors replace the usual yoke with a simple pin bearing by a double yoke, which has roller bearings to connect it with the piston-rod.—*April 29th*, 1932.



DYNAMOS AND MOTORS.

371,957. August 12th, 1931.—ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINES, The Electric Construction Company, Ltd., of Ingersoll House, 9, Kingsway, London, W.C. 2, and Louis John Hunt, of 28, Victoria-street, London, S.W.1.

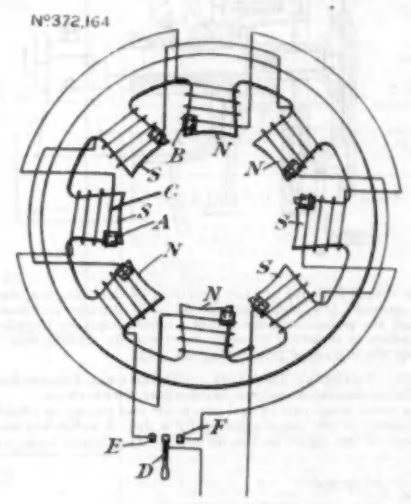
A scheme is described in this specification for stepping up the voltage applied to condensers used for raising the power factor of induction motors. The principle involved will be understood from Fig. 1, where a primary winding is illustrated which has to run from a three-phase alternating-current supply line A, B, C of, say, 400 volts, and in which condensers D, E, F are employed for power factor regulation and designed to operate with a potential difference of 600 volts. In this particular example, the primary winding is star-connected and each phase of the winding consists of two sections. The sections of the three phases A, B, C which lie between the line terminals and the neutral point have to carry both the line current and the current through the condenser. The ratio of the turns is rather less than 2 : 1 to compensate for the drop of potential due to the resistance of the primary winding. The line voltage may be stepped-down for application to the condensers. In Fig. 2 a three-phase primary winding is illustrated mesh-connected with the line voltage stepped-up to provide the voltage for application to the condensers. Examples of the invention are diagrammatically shown in Figs. 3 and 4. The motors illustrated have primary windings capable of cascade operation of the kind generally illustrated in the *Journal* of the Institution of Electrical Engineers, 1914, Vol. 52, pages 408 to 411. In Fig. 3 the mode of connection is generally of the same nature as in Fig. 1. The inner sections of the winding are the cascade windings, and the outer or single-purpose sections are single windings. In Fig. 4 the outer sections are parallel connected windings, each of half the number of conductors of each of the inner sections, and are provided with additional short-circuiting tappings H, J, and K, for the cascade speed. Thus, when the motor is operated in cascade, the outer sections may also carry tertiary currents



when the tappings H, J, and K are short-circuited. As the whole of the winding is available for carrying tertiary currents, it is more economical than that shown in Fig. 3. It will be noted, however, that the winding shown in Fig. 3 requires only half the tapping terminals of the winding shown in Fig. 4. Additional tappings may be provided along the single-purpose sections of the phases of the windings, particularly when the invention is applied to alternating-current generators, to enable the electromotive force applied to the condensers to be varied.—*May 5th*, 1932.

372,164. July 14th, 1931.—INDUCTION MOTORS, *Westinghouse Electric and Manufacturing Company, of East Pittsburgh, Pennsylvania, U.S.A.*

A single-phase reversible induction motor constructed in accordance with this invention has salient pole pieces A to receive a shading coil B, and if all the coils were energised together each alternate pair of poles would be of the same

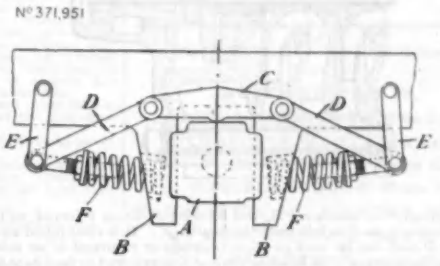


polarity as indicated by the letters N.S. But when the switch D closes the circuit at E four alternate poles are energised to provide north and south poles, and owing to the shading coils B the squirrel-cage rotor will rotate, say, in a clockwise direction. If, however, the circuit is closed at F the other four poles will be energised and the rotor will turn in the opposite direction.—*May 5th*, 1932.

TRAMWAYS AND RAILWAYS.

371,951. December 1st, 1930.—SPRING SUSPENSION SYSTEMS, S. A. Horstmann, Onega Lodge, Upper Bristol-road, Bath, and Horstmann, Ltd., James-street West, Bath.

In this arrangement of springing the axle-box A slides between



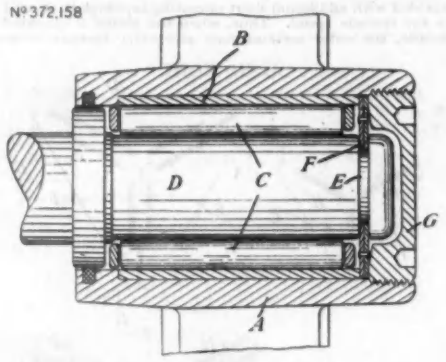
the horn-plates B B and its upward thrust is taken by the yoke C. This yoke is attached to the framing by the links D D and E E, and the weight is carried by the springs F F in compression, which abut against the horn-plates.—*May 2nd*, 1932.

372,158. July 9th, 1931.—ROLLER BEARING AXLE-BOXES, W. G. Allen and Sons (Tipton), Ltd., and W. H. Jones, Princes End, Tipton, Staffs.

In this bearing the hub A of the wheel has a hard liner B and

runs on the caged rollers C, which bear on the hardened surface of the axle D. A groove E is cut in the end of the axle and accommodates the plate F, which is made of several laminations to provide resiliency and is split diametrically, so that it can be put in place. The plate has radial notches to increase its re-

No 372,158



siliency, and while it keeps the wheel in place on the axle it allows a certain amount of end play. The plate is held in place in the hub by the screwed cap G, which is prevented from slacking back by the edges of the plate at the diametrical split being bent up after the fashion of a spring washer.—*May 5th*, 1932.

PUMPING AND BLOWING MACHINERY.

372,059. April 2nd, 1931.—CENTRIFUGAL PUMPS, Edgar Allen and Co., Ltd., Sheffield, and J. R. Broadley, 91, Psalter-lane, Sheffield.

This pump is evidently intended for working with gritty water, as is witnessed by the frequent use of the term pulp, instead of liquid or water, and the renewable nature of the wearing parts.

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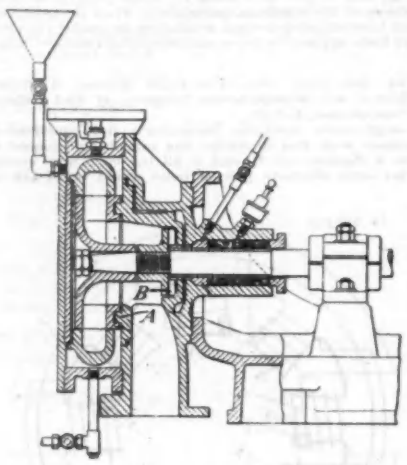

The principal features are the provision of the "sealing plate" A to prevent the regurgitation of pulp during its passage through the pump, and the use of a small auxiliary impeller B to produce a negative pressure in the shaft stuffing-box and prevent the ingress of grit.—*May 5th*, 1932.

372,242. November 21st, 1931.—CENTRIFUGAL PUMPS, Sulzer Frères Société Anonyme, Winterthur, Switzerland.

In a multi-stage centrifugal pump the end thrust on the shaft is balanced in the usual manner by a disc A subjected to the pressure of the liquid in the delivery. This liquid leaks away

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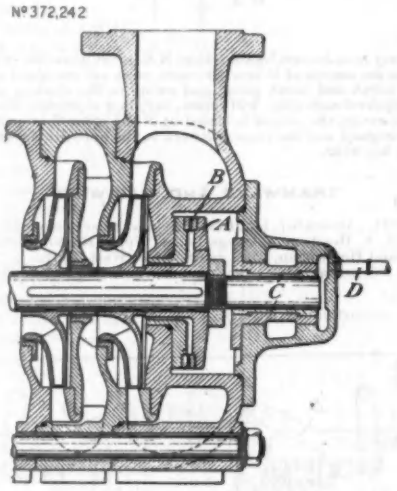

through the clearance B, but instead of being rejected to the suction is used to lubricate the bearing C. It is then piped away at D and can be used in other bearings or returned to an intermediate stage. The bearing bush at C is grooved to facilitate the passage of the liquid.—*May 5th*, 1932.

MOTOR CARS AND ROAD VEHICLES.

372,019. March 11th, 1931.—SELF-STARTER GEAR DRIVERS, R. G. Porte, 89, Marine-parade, Brighton, and R. F. Clement, 61, Norway-street, Portslade, Sussex.

The gear ring of the self-starter of a motor car drives the flywheel of the engine through a series of lugs, which are accommodated in recesses in the ring and the periphery of the flywheel. There is sufficient play between the lugs and the recesses to allow a certain amount of relative rotary movement, so that

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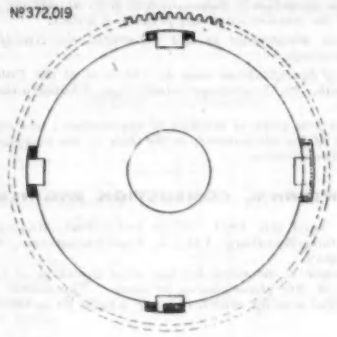

shocks can be absorbed by springs placed in the recesses. The illustration shows several alternative arrangements.—*May 5th*, 1932.

MISCELLANEOUS.

371,719. July 31st, 1931.—ELECTROLYTIC PRODUCTION OF ALUMINIUM, Aluminium-Industrie Aktiengesellschaft, of Neuhausen, Switzerland.

This invention relates to the electrolytic production of aluminium. In aluminium electrolysis in a fluoride bath, according to the method of Héroult, the liquid aluminium sinks and collects on the cathode bottom under the fluoride electrolyte, which has a lower specific gravity than the molten metal. The aluminium has to be removed periodically and this can be carried out in various ways, all of which present disadvantages. In accordance with the invention, these disadvantages are overcome by removing the liquid aluminium from the furnace by means of a mechanically operated device. The screw A is arranged coaxially in the conical receiver B and is driven by the compressed air motor C supported on the top of the receiver. The liquid aluminium flows through the bottom hole D into the receiver B, is raised by means of the screw up to the spout E, and flows away through it. The expanded air which comes from

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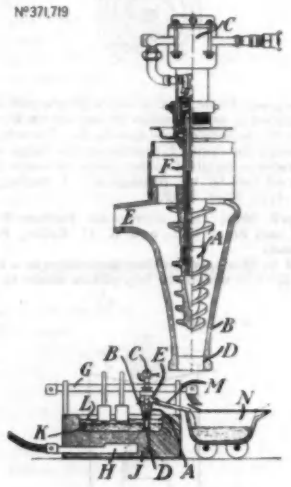
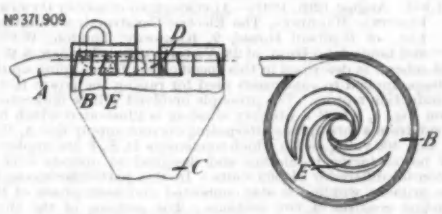


the motor C is led through the driving shaft F into the screw, ascends in the screw and finally escapes, after having exerted its cooling action. The furnace for the electrolytic production of aluminium has a positive electric conductor G, anodes, and a cathode connection H moulded in the bottom. J designates the refractory lining, K the molten aluminium, and L the molten cryolite electrolyte. The apparatus, shown enlarged in the upper part of the drawing, is inserted from time to time at the right of the furnace, where a carbon electrode has been removed in order to make room for the receiver of the apparatus. The screw A removes the aluminium in a continuous stream, while the apparatus is in operation, and the metal flows into the receiver B through the bottom hole D up to the spout E. The metal then runs along a channel M into a transportable receiver N. As the removal of aluminium is comparatively rapid, the apparatus need remain in position for only a relatively short time and thus the likelihood of contamination of the aluminium by the metal of the apparatus is reduced.—*April 28th*, 1932.

371,909. December 31st, 1930.—CYCLONE SEPARATORS, T. F. Hurley, H.M. Fuel Research Station, Blackwell-lane, East Greenwich, S.E. 10.

This cyclone is intended for separating the coarser particles from the fines of powdered coal intended for burning in furnaces. The powdered coal is blown into the apparatus by the duct A and enters the annulus B in the upper part of the casing C. This annulus is connected with the outlet D by a series of scroll-shaped passages E E, which have sloping outer faces, as shown.

No 371,909



At the bottom of these faces there are slots for the escape of the heavier particles into the hopper. On entering the various ducts E, the air will be given an equiangular spiral motion; that is, the same motion as it would take up without vanes in a vortex chamber. The power absorbed by the apparatus will, the inventor says, therefore be no greater than in any ordinary cyclone. At any point in the ducts the air may be considered instantaneously to be travelling in a circle having the same radius as the radius of curvature of the equiangular spiral at that point. Now in vortex movement v is proportional to the reciprocal of the distance from the axis and v decreases rapidly as the axis is approached. It follows that if the ducts are designed so that the air passing through them follows spiral vortex motion, the tendency for separation to occur will increase very rapidly indeed, as the air approaches the centre and the apparatus should therefore be much more efficient as a dust remover than any of the normal "Cyclone" or other centrifugal separators.—*May 2nd*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTE OF BRITISH FOUNDRYMEN.—Annual Conference at Newcastle-upon-Tyne. Particulars may be obtained from the Hon. Conference Secretary, Mr. J. W. Eckford, 4, Mosley-street, Newcastle-upon-Tyne.

INSTITUTION OF GAS ENGINEERS.—Park-lane Hotel, Piccadilly, W. 1. Sixty-ninth annual general meeting. Tuesday: Opening session, 10 a.m. Presidential address by Mr. J. Herbert Canning. Presentation of medals. Paper, "The Co-ordination of Power Relative to Gasworks," by Mr. F. M. Birks. President's luncheon to the Council, 12.45 p.m. General meeting of the Benevolent Fund, 3 p.m. Paper, "The Use of Gas as a Fuel in Industry, with Special Reference to Future Applications," by Dr. C. M. Walter, 3.15 p.m. Reception and dance, 9 p.m. to 2 a.m. Wednesday: Papers, "Ten Years' Carbonising in Vertical Retorts," by Mr. J. E. Blundell; "Gas Fire Flues and Ventilation," by Mr. C. A. Masterman, 10 a.m. Council luncheon to the President, 12.45 p.m. Visit to the works at Beckton of the Gas Light and Coke Company, 2 p.m. Thursday: Papers, "A Method of Analysing Gas Output Curves," by Dr. J. S. G. Thomas; "The Results of Constructive Policy as Applied to a Small Gas Undertaking," by Mr. W. Clark Jackson, 10 a.m. Visit to the Chemical Works and the Metro-coalite plant of the South Metropolitan Gas Company at East Greenwich, 2 p.m. Friday: Sussex tour. Leave Victoria Station, 9.20 a.m. train.

WEDNESDAY, JUNE 15TH.

SOCIETY OF GLASS TECHNOLOGY.—Luncheon, King's Head Hotel, Sheffield, 12.30 p.m. In the Applied Science Department, the University, St. George's-square, Sheffield. "A Study of the Volatilisation of Glass: The Behaviour of the Soda-silica Glasses," by Mr. Eric Preston and Professor W. E. S. Turner; "Statistical Methods for the Routine Testing of Bottles," by Mr. F. C. Flint and Mr. A. K. Lyle (communication from the laboratories of the Hazel Atlas Glass Company, Washington, Pa., U.S.A.); "The Ageing of Glassware," by Mr. J. B. Murgatroyd (communication from the laboratory of the British Hartford-Fairmont Syndicate, Ltd., Greenford); "The Properties of Clay Mixtures Suitable for Glass House Pots," by Dr. J. H. Partridge (communication from the research laboratories of the General Electric Company, Ltd., Wembley). 2 p.m.

STAFFORDSHIRE IRON AND STEEL INSTITUTE.—Visit to Port of London. Leave Wolverhampton 8.7 a.m., Dudley Port 8.18 a.m., and New-street, Birmingham, 8.40 a.m.

WEDNESDAY TO FRIDAY, JUNE 15TH TO 17TH.

INSTITUTION OF MINING ENGINEERS.—Summer meeting at Sheffield. Wednesday, general meeting at the Royal Victoria Hotel, Sheffield. Address of welcome by the Lord Mayor of Sheffield. Presentation and discussion of papers, 11 a.m. The meeting will be adjourned at 1 p.m. and resumed at 2.30 p.m. Reception of members and ladies by the Lord Mayor and the Lady Mayoress of Sheffield at the Town Hall, 4.30 p.m. Reception of members and ladies at the Royal Victoria Hotel, Sheffield, by the President and Council of the Midland Institute of Mining Engineers, followed by a cabaret show and dance, 8.30 p.m. Thursday, visits to various works, 10.30 a.m. Institution of Mining Engineers' dinner at the Royal Victoria Hotel, Sheffield, followed by informal dance, 7.30 p.m. Friday, visits to various works, 11 a.m.

WEDNESDAY, JUNE 15TH, TO SATURDAY, JUNE 18TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Glasgow. Fifty-ninth annual general meeting and conference.

FRIDAY, JUNE 17TH.

ILLUMINATING ENGINEERING SOCIETY.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. Annual general meeting, 6.30 for 7 p.m. Presidential address by Sir Francis Goodenough, 7.15 p.m.

TUESDAY TO SATURDAY, JUNE 21ST TO 25TH.

BRITISH WATERWORKS ASSOCIATION.—Bournemouth. Annual general meeting and conference. For programme see page 422.

WEDNESDAY, JUNE 22ND.

MANCHESTER ASSOCIATION OF ENGINEERS.—Visit to works of Alfred Herbert, Ltd., Coventry. Leave Manchester (London-road), 8.30 a.m.

FRIDAY, JUNE 24TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS: WEST MIDLAND DISTRICT.—Meeting at Stratford-on-Avon. Assemble at front entrance Shakespeare Memorial Theatre. 3 p.m.

SUNDAY TO SUNDAY, JUNE 26TH TO JULY 10TH.

WORLD POWER CONFERENCE.—Sectional meeting in Scandinavia. For provisional programme see page 405.

FRIDAY, JULY 1ST.

OVERHEAD LINES ASSOCIATION.—Summer meeting at Chesham. For provisional programme see page 513.

SATURDAY, JULY 2ND.

DIESEL ENGINE USERS ASSOCIATION.—Summer Meeting. Visit to m.v. "Asturias" at Southampton. Presidential Address by Mr. C. M. Mayson.

MONDAY TO TUESDAY, JULY 4TH TO 12TH.

INTERNATIONAL ELECTRICAL CONGRESS, 1932.—Particulars may be obtained by intending British visitors from the Secretary of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2.

TUESDAY, JULY 5TH, TO SATURDAY, JULY 9TH.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.—Royal Show at Southampton.

THURSDAY, JULY 7TH.

BRITISH ELECTRO-FARMING CONFERENCE.—Members' Tent, Show Yard, Royal Agricultural Society, Southampton. 3 p.m.